NUCLEAR SCIENCE ABSTRACTS

Volume 1 Number 11

Contents for December 15, 1948

Chemistry Library

QC
770
.U56
V.1
no. 11

Subject Category	Page
Absorption and Scattering of Radiation	496
Astrophysics	496
Atomic Power	497
Biological Effects of Radiation	497
Biology, General	499
Botany	500
Ceramics	501
Chemistry, Analytical	503
Chemistry, General	505
Control of Atomic Energy	506
Corrosion and Anti-Corrosion	506
Cosmic Radiation	506
Crystallography and Crystal Structure	508
Deuterium	510
Fluorocarbons	511
Geophysics	512
Graphite	512
Health Protection	512
Instruments	513
Isotopes	515
Mass Spectra	516
Mesons (Mesotrons)	516
Metallurgy	517
Mineralogy	519
Neutrons	519
Nuclear Physics - Methods of Measuring	522
Nuclear Properties	525
Nuclear Transformation	528
Particle Accelerators	530
Physics, General	531
Physics, Nuclear	535
Physics, Theoretical	536
Radiation Sickness	537
Radioactivity	537
Radiography	539
Radiotherapy	539
Rare Earths	540
Scientific Research and Laboratories	541
Spectroscopy	542
Tracer Applications	544
Tracer Applications, Radioactive	544
Transuranic Elements	545
Uranium	546
Vacuum Systems and Pumps	548

Indices follow page 548

Location List of Atomic Energy Commission Declassified Documents

Document	Abstract No.	Page
AECD-2369	1856	519
AECD-2370	1789	505
AECD-2371	1857	520
AECD-2372	1765	499
AECD-2373	1892	528
AECD-2374	1858	520
AECD-2375	1959	545
AECD-2376	1960	545
AECD-2377	1963	546
AECD-2378	1859	520
AECD-2379	1860	520
AECD-2380	1826	513
AECD-2381	1964	546
AECD-2382	1752	496
AECD-2383	1893	528
AECD-2384	1817	511
AECD-2385	1818	511
AECD-2386	1819	511
AECD-2387	1781	503
AECD-2388	1965	546
AECD-2389	1938	540

Atomic Energy Unclassified Documents

Document	Abstract No.	Page
NEPA-258	1790	505
NEPA-635	1869	523
NEPA-812	1775	502
ORNL-174	1760	497
ORNL-180	1767	500
ORNL-186	1867	522
Y-268	1827	513
Y-271	1805	508

ABSORPTION AND SCATTERING OF RADIATION

1752 Alpha Particles from Fission as Recorded by Photographic Emulsions, by L. Marshall. AECD-2382 (ANL-HDY-530), July 8, 1948, decl. November 15, 1948. 23p. For publication in Physical Review. Document for sale by AEC.

Eighty long range alpha particles coincident with U^{235} fission have been observed in photographic plates. There was a tendency for the alpha particles to emerge with greatest energy at an angle slightly greater than 90° from the heavy fragment. In accordance with previous observers, it was found that most alpha particles emerge approximately perpendicular. It was also found that the majority from an angle slightly obtuse to the heavy fragment. The energy of the alpha particles was found to be derived largely from the kinetic energy of the fission fragments. The alpha emitting fissions were found to have approximately the same mass ratio as do normal fissions.

1753 On the Scattering of Protons by Protons, by W. H. Ramsey. Proceedings of the Royal Society 194A, No. 1037, August 12, 1948.

The features of the scattering of protons by protons are calculated using the Møller-Rosenfeld version of the meson theory of nuclear forces. A comparison with the experimental material suggests that the neutron-proton interaction is slightly stronger than that between two protons. The predictions of the theory fit the experimental results best when the meson mass is assumed to be about 270 electronic masses. This is significantly larger than that indicated by cosmic-ray measurements, and it is also greater than the values found by using the theory to calculate the features of neutron-proton scattering and the binding energies of the lightest nuclei.

1754 Small-Angle X-Ray Scattering from Amorphous Materials, by George H. Vineyard. Physical Review 74, p. 1076-1083, November 1, 1948.

The causes of excessive x-ray scattering at small angles from amorphous materials are discussed, and a formula is derived for the scattered intensity from a substance containing definite macroscopic regions of inhomogeneity, such as clumps of molecules, pockets, or foreign inclusions. The formula shows the effect of both macroscopic and microscopic molecular arrangements. Some previous observations of small-angle scattering from liquid and gaseous argon are examined in the light of this theory, to see whether they may be accounted for by heterophase fluctuation phenomena. A model with small droplets of liquid included in the vapor phase, and small bubbles of vapor included in the liquid phase is considered, and in order to explain the observations a droplet radius of about 5 angstroms is found necessary. This is considered too small to be plausible, and alternative explanations on the basis of less sharply defined density fluctuations are suggested.

ASTROPHYSICS

1755 Thermonuclear Reactions in the Expanding Universe, by R. A. Alpher, R. Herman, and G. A. Gamow. Physical Review 74, p. 1198-1199, November 1, 1948. (Letter to the editor)

The significance of the high prevailing temperature in the expanding universe following the essential completion of the main element-forming process previously described (Alpher, Bethe, and Gamow, Physical Review 73, p. 803, 1948) is discussed. As a result of thermonuclear reactions with protons, changes in the relative abundances of the lighter elements would be expected to occur. The relative abundance data suggest that the abnormally low abundances of certain of the light elements, such as lithium, beryllium, and boron, resulted from thermonuclear destruction of these nuclei with the concomitant formation of additional helium. Unlike the other light elements, these are found to have large cross sections for proton reactions (Bethe, Physical Review 55, p. 434, 1939). It is shown that for certain of the light elements the difference between the present relative abundance and the abundance computed according to the neutron capture process is consistent with known thermonuclear reaction and cosmological information afforded by the neutron capture process. In order to explain the present extremely low abundances of Li, Be, and B by thermonuclear destruction one must assume that the

ASTROPHYSICS (continued)

process became important at about $t_o \sim 10^3$ sec (where t_o is the time at which the proton reactions become important). This value of t_o is of the correct order of magnitude for the time at which the neutron capture process became unimportant, which supports the theory advanced by the authors. The same analysis applied to other light elements, such as F^{19}, which also have rather low abundances compared to their computed values, yields a similar result. Elements involved in the carbon-nitrogen cycle reactions do not show any appreciable depletion because of thermonuclear reactions in the expanding universe.

ATOMIC POWER

1756 The Atomic Pile, by S. W. Clatworthy. Popular Mechanics 90, No. 4, p. 96-97, October 1948.

A picture diagram of the atomic pile is accompanied by a brief explanation of its operation. The drawing, which was based on official reports, is necessarily conjectural with regard to the construction details. The author claims this is the first detailed illustration of an atomic pile to be made public.

1757 Commentary: Atomic Energy, by E. P. Wigner. Research 1, p. 577-580, October 1948.

This article is based on a paper read before the American Association for the Advancement of Science at their centenary celebrations. The broad features of an arrangement in which uranium can be used for the generation of energy are described. The cost of atomic energy as compared to coal and oil is given. Trends for the future are considered. 11 references.

1758 Elementary Principles of Atomic Energy, by E. R. Lapp. Armed Forces Special Weapons Project (Indoctrination course for Medical Officers), n.d. 24p.

Lectures are given on the dimension of nuclear particles and magnitude of nuclear forces. The concept of the electrical nature of matter is introduced. Ionization, nuclear radiation (alpha, beta particles and gamma rays), isotopes, disintegration, rate of disintegration, nuclear fission, $E = mc^2$, chain reaction, and radioactivity induced by neutrons are briefly explained. 15 references.

1759 Engineering Aspects of Atomic Energy (Uses of Metals in the Process), by Guy S. Dutton. Overseas Engineering 20, p. 194-196, 1947.

A review is presented of the principles involved in the process of nuclear fission. Beryllium, heavy water and graphite make effective moderators. Cadmium and boron-steel absorb neutrons and are used to control the reaction. Aluminum is used to make the cans in which the uranium slugs are sealed because of its ability to withstand corrosion.

BIOLOGICAL EFFECTS OF RADIATION

1760 The Induction of Mutations in Paramecium Aurelia by Beta Radiation, by R. F. Kimball. Oak Ridge National Laboratory Report ORNL-174, October 29, 1948. 26p.

Beta radiation from an external P^{32} source in doses up to 13,000 rep has no immediate marked effect upon vegetatively multiplying Paramecium aurelia. When the progeny of rayed animals are sent through autogamy, many of the exautogamous clones are of reduced vigor as judged by total growth in four days. This reduced vigor is interpreted as the expression of mutational changes in the micronuclei partly because it first appears when the animals are made homozygous by autogamy, partly because data on inheritance to be published in a separate paper support this view. Radiation given in a period of about an hour before cytoplasmic division is less effective than radiation given at other stages of the fission cycle. No adequate explanation is available for this phenomenon.

BIOLOGICAL EFFECTS OF RADIATION (continued)

The relation of the percentage of exautogamous clones of reduced vigor to dose shows that most of the mutational changes cannot be gene mutations with individually detectable effects. The relation is consistent either with the hypothesis that most of the effect is due to two-hit chromosomal aberrations or with the hypothesis that most of it is due to the combined action of several mutant genes with individually undetectable effects. Fractionation of the dose has no noticeable effect on dosage relations so two-hit chromosomal aberrations cannot be an important factor. This leaves the hypothesis that most of the detectable reduction in vigor is due to the combined effect of mutant genes with individual effects too small to be detected. This hypothesis gives expectations in agreement with the dosage relations and is further supported by the fact that a number of clones which appear normal by the usual test for vigor prove to be of reduced vigor when examined by a more refined method. The mathematical relation between the average fraction of exautogamous clones of reduced vigor and the mean number of mutations per micronucleus has been worked out for this hypothesis. By approximation calculations, a value of about two mutations per micronucleus per 1000 rep has been obtained.

1761 An International Bibliography on Atomic Energy, Scientific Aspects, Volume II, Parts III (The Biological and Medical Effects of High Energy Radiation) and IV (Isotopes in Biology and Medicine). United Nations Atomic Energy Commission, September 17, 1948. 338p. (NP-418)

The present document is a preliminary edition and comprises Parts III and IV of "An International Bibliography on Atomic Energy." References are listed under the following headings in Part III: Effects of high energy radiations on chemical compounds, on microorganisms, on cells, on genetics and mutations, on the growth and development of organisms, an organ systems, on physiology, and on botany and agriculture; medical aspects of high energy radiations; radiation protection and dosage measurement; and technical aspects. Part IV includes introductory essays on stable isotopic tracers and on the uses of radioactive isotopes, and references are listed under the following headings: General articles on tracers; agriculture and ecology; physiological chemistry; physiology; medicine and toxicology; technique.

1762 The Cytogenetic Effect of Sonic Energy Applied Simultaneously with X-Rays, by Alan D. Conger. Proceedings of the National Academy of Sciences 34, p. 470-474, October 1948.

The cytogenetic effects of simultaneous treatment of Tradescantia inflorescences with x-rays (250 r) and sonic energy (9100 cycles/second) are described. Simultaneous treatment with sonic energy and x-rays increases the yield of x-ray induced chromosomal aberration about 1.3 times the yield obtained with the same amount of x-rays alone. The sonic treatment alone did not cause aberrations. The increased yield is probably due to an increased movement of chromosomes and chromosome fragments caused by the sonic treatment resulting in a decrease in the amount of restitution and an increase in the amount of detectable new reunions between the broken ends of chromosomes.

1763 Histopathology of Irradiation from External and Internal Sources. Edited by William Bloom. Authors: Margaret A. Bloom, William Bloom, Peter Paul Henry De Bruyn, Minnie Heller, Raymond G. Murray, Mila Pierce, Ruth P. Rhoades, Ray S. Snider, and George Svihla. New York, McGraw-Hill Book Company, 1948.

This is one of the first available volumes of the National Nuclear Energy Series, Manhattan Project Technical Section. It was prepared by the Histological Group of the Health Division at the University of Chicago, and covers a wide variety of experiments and gives detailed information on techniques and materials. Among the radioactive agents used in these experiments were beta and gamma rays, fast and slow neutrons, and x-rays to establish a base line for comparison. The effects of sodium 24, carbon 14, yttrium 91, radium and many others were studied. The isotopes were administered intramuscularly, intravenously, intracardially, or intraperitoneally. The volume describes the histopathological and cytological effect of radioactive agents in the cells, skin, bone, bone marrow, spleen, lymph

BIOLOGICAL EFFECTS OF RADIATION (continued)

node and intestinal lymphatic tissue, the thymus, gastrointestinal tract, structures accessory to the gastrointestinal tract, testis, ovary, kidney, lung, vascular system, adrenal, nervous system, etc.

1764 X Irradiation of the Hypophysectomized Rat, by H. M. Patt, M. N. Swift, E. B. Tyree, and R. L. Straube. Science 108, p. 475-476, October 29, 1948.

In order to determine whether hypophysectomy would prevent adrenal response to x-radiation and to note whether survival and some of the typical changes in organ weights would be altered, 30 white male rats were hypophysectomized 1 week prior to a single exposure of 750 r (200 kv; dose rate 18r/min). The animals were sacrificed 3 hrs and 4 days after irradiation and the adrenals, spleen, thymus and left kidney were removed. The per cent changes in organ weights and in adrenal cholesterol were determined. Hypophysectomy appeared to potentiate x-ray toxicity. It was concluded that the initial, intermediate, and terminal adrenal changes resulting from x-ray exposure were prevented by the operation, and that under these conditions the extent of the splenic and thymic involution is not altered, although toxicity appears to be enhanced. 11 references.

BIOLOGY, GENERAL

1765 Studies of the Metabolism and Toxic Action of Injected Radium. Part II. The Hematological Effects of Parenterally Administered Radium; A Comparison of Plutonium and Radium Effects, by Leon O. Jacobson and Eric L. Simmons. AECD-2372 (CH-3884), June 1946, decl. November 3, 1948. 103p. For publication in NNES.

The effects of the parenteral administration of radium chloride on the hematological constituents of the peripheral blood of rats, mice, and rabbits have been studied. Intraperitoneal and intravenous doses of from 0.005 to 0.94 μc/g have been given to rats; intraperitoneal doses of from 0.000066 to 0.85 μc/g, to mice; and intraperitoneal or intracardial doses of from 0.0016 to 0.1 μc/g, to rabbits. There appeared to be no significant species difference in the sensitivity of the hemopoietic systems. of the rat and mouse to radium, but rabbits appeared to be slightly more resistant than the other two species. Also, CF-1 female mice appeared to be somewhat more resistant than ABC male mice, but whether this was a strain or sex difference has not been ascertained.

In the rat, mouse, or rabbit no significant hematological alteration occurred after an injection (by any route) of 0.01 μc/g or less of radium chloride. A dose of 0.02 μc/g produced an anemia and sustained leucocyte reduction in rats. A dose of 0.03 μc/g resulted in a severe recurrent anemia in ABC male mice (but not in CF-1 females), comparable changes in heterophil levels in both strains, and in an initial moderate reduction in lymphocytes in the ABC male mice. Doses as high as 0.1 μc/g, however, failed to produce an anemia in the rabbit, but did cause a mild, early, persistent reduction in leucocytes. A dose of 0.94 μc/g in the rat resulted in an initial reduction in reticulocytes with subsequent overproduction and in a marked reduction in platelets with only moderate recovery.

Morphological changes were seen in the nucleated cells of the peripheral blood after radium administration. These were largely comparable to those previously described in animals following the external application of radiations such as X-rays, γ-rays, and fast neutrons, or internal radiation in animals following the parenteral administration of plutonium. As evidenced by an increased erythrocyte diameter and increased mean corpuscular hemoglobin, macrocytosis became apparent in rats, mice, and rabbits after the parenteral administration of doses of radium between 0.1 and 0.2 μc/g.

1766 The Effect of Topically Applied Antihistaminic Drugs on the Mammalian Capillary Bed, by T. J. Haley and D. H. Harris. UCLA Atomic Energy Project Report UCL-1, October 15, 1948. 24p.

A study of the peripheral vascular effects of topically applied antihistaminic drugs showed that they caused vasoconstriction at the precapillary sphincters by a direct action on the muscle cells. This effect was not mediated through either the cholingeric or adrenergic branches of the autonomic nervous system. Evaluation of this group of drugs by this method demonstrated that Neonantergan, Thephorin, Phenergan and Benadryl were the most potent compounds of the entire series.

BIOLOGY, GENERAL (continued)

1767 Enzymatic Hydrolysis of Peptides of Asparagine, by C. E. Carter. Oak Ridge National Laboratory Report ORNL-180, November 2, 1948. 23p.

An investigation of the enzymatic hydrolysis of the amide and peptide bonds of glycyl, chloroacetyl, and dl-leucyl-l-asparagine by extracts of mammalian tissues is reported. Glycyl-l-asparagine is found to hydrolyze rapidly in aqueous extracts of several mammalian tissues. In aqueous extracts of rat liver the hydrolysis of the peptide bond precedes that of the amide. The pH optimum of the peptidase which splits glycyl-l-asparagine is at 8.0 and the kinetics of the reaction are first order. Glycyl-dl-asparagine and dl-leucyl-l-asparagine are hydrolyzed much more slowly than glycyl-l-asparagine in purified tissue extracts. A fraction prepared from calf thymus has high peptidase and no amidase activity for glycyl-l-asparagine.

1768 The Pharmacology and Toxicology of Uranium Compounds. Edited by Carl Voegtlin and Harold C. Hodge. New York, McGraw-Hill Book Company, 1948.

This is one of the first available volumes of the National Nuclear Energy Series, Manhattan Project Technical Section. It summarizes years of research and many experiments on the toxicity of uranium compounds and the mechanism of uranium poisoning. Experiments on the toxic qualities of uranium compounds were made preceding various conditions, such as exposure by inhalation of dust or fumes, by skin and eye application, and by oral and parenteral administration. Large scale acute tests were made of the degree of air contamination by uranium compounds. The problems of aerosol production, control, and measurement are described; details are given on such aspects as the relationship of particle size to toxicity and the adaptation of the cascade impactor for routine dust measurements. Emphasis is placed on the mechanism of action of uranium. The physico-chemical rules which govern the formation of uranium-protein complexes and bicarbonate complexes are applied to the transport of uranium in the body and to its excretion through the kidney. The characteristic uranium in the kidney is described from histopathological and from function studies. The role of citrate in tolerance is also covered. Many of the methods and techniques are given in detail, such as the measurement of catalase in urine and the standardization of toxicological procedures for large scale investigation. New uranium methods presented are: skin and eye toxicity, the analytical method, inhalation toxicity, distribution and excretion, theory tolerance, enzyme and protein effects and the catalase method.

1769 Some Sources of Intake and Methods of Elimination of Fluorine, by L. Spiro. Acta Medica Scandinavica 130, p. 78-96, 1948.

There is a close similarity between fluorine and arsenic in toxicological action and method of excretion. Appreciable quantities of fluorine have been detected in the hair and nails in a case of chronic fluorine poisoning. Analysis of numerous items of food shows that although some contain fluorine only in very low concentrations, others are heavily contaminated; and in most cases fluorine is found to be associated with arsenic. Artificial fertilizers and chemicals used for sterilizing and filtering water contain considerable amounts of fluorine. It is suggested that the limits proposed by the Interdepartment Committee (Analyst, 71, p.382, 1946) for fluorine in food are excessive and that they should be set to conform to the limits prescribed for arsenic, as the toxicity of both noxa are practically identical.

BOTANY

1770 Influence of Radioactive Elements upon the Lives of Plants, by A. A. Drobkow. NP-331, n.d. 15p. (Translation by Boris Pregel)

Photographs and other data are presented in support of the proposition that the growth of plants responds to the presence in the soil of micro quantities of radioactive elements. The work of Soviet scientists in this field are reviewed briefly; the authors own experiments are also discussed. It is concluded that the most beneficial dosage for plant growing in water and sandy soils in 10^{-9} to 10-11g of radium and 10^{-4} and 10^{-5}g of thorium per liter of the nutritive solution or per kg of sand.

CERAMICS

1771 The Effect of Smelting Time on the Properties of a Refractory Base Coat, by J. E. Comeforo and W. G. Bennett. University of Illinois Department of Ceramic Engineering Memorandum Report No. 11 (Air Materiel Command Contract), November 12, 1947. 11p. (NP-143)

The changes produced in the properties of a refractory base coating by variations in the length of smelting time of the frit are reported. The investigation indicated that the properties of a frit may be drastically altered by varying the smelting time. By exercising proper control over the smelting operation it may be possible to change certain characteristics of the frit as desired without recourse to alterations of the batch composition. With the frit studied, the softening point varied 170°F, the cubical coefficient of expansion ranged from 287 to 231 ($\times 10^{-7}$), and the maximum firing temperature (a measure of refractoriness) of a coating made with the frit ranged from 1750 to 2050°F when smelted for various lengths of time. In addition, the viscosity and length of firing range changed markedly with different smelting periods.

1772 High-Temperature Attack of Various Compounds on Four Heat-Resisting Alloys, by D. G. Moore, J. C. Richmond and W. N. Harrison. National Advisory Committee for Aeronautics Technical Note No. 1731, October, 1948. 20p.

In the preparation of suitable protective ceramic coatings for heat-resisting alloys, indications were that certain of the common coating ingredients were reacting with the alloys and thereby limiting the life of the coated specimens at the temperatures of operation. This effect was acute in the case of Hastelloy B alloy. In order to obtain a preliminary indication of the identity of the ingredients that were causing the difficulty, a total of 61 compounds, all of which contained elements that have been or might logically be used in coatings, were tested by placing a small pulverized sample of each compound on the cleaned surface of an alloy specimen and heating in air for 17 hours at 1500°F. Visual examinations were then made to determine the degree of attack if any. The results indicate: (1) That Hastelloy B is much more susceptible to heavy attack by corrosive coating ingredients when heated in air than the other three alloys studied (S-816, S-590, and Haynes Stellite No. 21), (2) that of the components that reacted with the alloys, the alkalies, lead compounds, and some of the alkaline earths gave the most pronounced attack, (3) that the attack of the alkalies on Hastelloy B does not occur in a carbon-dioxide or a helium atmosphere, and (4) that it should be possible to prepare coating compositions which will permit the ceramic coating of high-molybdenum alloys to prolong their life under operating conditions which now produce early deterioration.

1773 Refractory Oxides as Materials of Construction for Rocket Motors, by J. A. Slyh et al. Battelle Memorial Institute Report No. 37 (Office of Naval Research Contract), October 15 - November 15, 1947. 16p.

The resistance of specimens made from pure shellac bonded MgO to cracking or spalling during the torchfiring test either did not change appreciably or tended to decrease as the temperature was increased from 2800° to 4200°F. The size of the MgO crystals increased when the burning temperature was increased from 3000° to 4000°F. Addition of 0.8 to 3.7% by weight of MgF_2 to the shellac-bonded MgO body retarded the growth of crystals during burning at 4300°F. A specimen formed from a mixture of 50% Al and 50% Al_2O_3 by weight was more resistant to severe thermal shock than pure, sintered Al specimens. Specimens formed from a mixture of 70% ZrO_2, 27.3% plaster of Paris, and 2.7% graphite did not fuse or spall when subjected to the torch firing-test, although cracking was serious.

1774 A Study of Ceramic Coatings for High-Temperature Protection of Molybdenum, by D. G. Moore, L. H. Bolz, and W. N. Harrison. National Advisory Committee for Aeronautics Technical Note No. 1626, July 1948. 31p. (NP-270)

Specimens of molybdenum were covered with a protective ceramic coating and then given tests which included heating at constant temperature in an air atmosphere, heating in a gas-oxygen flame,

CERAMICS (continued)

thermal-shock tests, and service testing in the blast of ram-jet engines. Results indicated that oxidation of the molybdenum was greatly retarded by the best of the coatings and that short-time (10 to 45 min) protection of molybdenum in oxidizing atmospheres at gas temperatures up to 3500°F is possible. Composition and physical characteristics of the coatings and results of the tests are presented in tabular form.

1775 The Thermal Conductivity of a Hot Pressed Be_2C Cylinder, by James B. Trice, John J. Neely, and Charles E. Teeter, Jr. Fairchild Engine and Airplane Corporation Report NEPA-812, November 3, 1948. 12p.

The thermal conductivity of a hot pressed beryllium carbide cylinder was measured roughly by the method of radial heat transfer. Heat was supplied by a central globar heater and the temperature drop across the cylinder wall was measured by thermocouples. Results varied from .0136 watts cm^{-2} $(°C\ cm^{-1})^{-1}$ or 0.78 BTU ft^{-2} hr^{-1} $(°F\ ft^{-1})^{-1}$ at 324°C (610°F) to .0241 watts cm^{-2} $(°C\ cm^{-1})^{-1}$ or 1.38 BTU ft^{-2} hr^{-1} $(°F\ ft^{-1})^{-1}$ at 900°C (1650°F). The results were represented graphically by a straight line with a standard deviation of 0.0006 watts cm^{-2} $(°C\ cm^{-1})^{-1}$ and analytically by the relation $K(T) = 0.15 \times 10^{-4}\ T + 87 \times 10^{-4}$, where K(T) is expressed in watts $cm^{-2}(°C\ cm^{-1})^{-1}$.

1776 The Development of Refractories for High-Temperature Industrial Processes, by A. Hilliard and J. H. McKeel. Bulletin of the British Coal Utilization Research Association 11, p.457-468, 1947.

This is a brief review of the subject. The physical considerations in the manufacture of refractories, and the allotropic and chemical changes which occur upon heating are discussed. The more common refractories are classified according to their chemical properties. Considered briefly are such special refractories as oxides, carbides, nitrides, and borides. The different types of insulating refractories are described. 118 references.

1777 Dielectric Properties of Mixed Barium and Strontium Titanates at 10,000 Mc./s., by J. G. Powles. Nature 162, p. 655, October 23, 1948.

Measurements have been made of the complex permittivity of a series of mixed barium and strontium titanates at 9,450 Mc/sec and 20°C, using a technique, already described (Nature 161, p. 25, 1948; 162, p. 614, 1948), which employs a wave-guide containing a multilayer dielectric slab. The relative permittivity and the ratio of the real component to the imaginary component are plotted as functions of the percentage of barium titanate by weight for frequencies of 9,450 Mc/sec and 1.5 Mc/sec. A graph of the ratio of the relative permittivities for the two frequencies as a function of the percentage of barium titanate by weight is also given.

1778 Dielectric Properties of Titanates at Ultra-high Frequencies, by J. G. Powles. Nature 162, p. 614, October 16, 1948.

The complex permittivity of the titanates of magnesium, calcium, strontium, and barium has been measured at 21°C and frequencies of 1.5 and 9,450 Mc/s. A measurement at 24,000 Mc/s was also made for barium titanate, and the lower frequency values for this compound were studied in the 20-170°C range. The dielectric properties of the 4 compounds are compared in tabular form and the temperature range curves of the barium titanate data are shown. With increasing frequency the permittivity values were found to decrease appreciably in the case of the barium titanate, indicating the existence of dispersion in the ultra-high frequency ranges for barium titanate. There was little change with frequency for the other compounds. The curve of temperature variation in permittivity shows that at all four frequencies a steep peak occurs at approximately 118°C.

1779 Electrostrictive Effect in Barium Titanate Ceramics, by W. P. Mason. Physical Review 74, p. 1134-1147, November 1, 1948.

When a direct current bias is applied to a multicrystalline barium titanate ceramic, an alternating voltage can excite resonances in the ceramic. Four modes of motion have been excited—a

CERAMICS (continued)

longitudinal mode at right angles to the applied field, a radial mode of a circular plate at right angles to the applied field, a thickness longitudinal mode, and a thickness shear mode. The first three are excited when the ac field is applied in the same direction as the dc polarization, but the fourth is excited when the ac field is at right angles to the dc polarization. The amount of motion is larger than in magnetostrictive materials, and it appears that barium titanate may be an important electromechanical transducing element.

All of these modes can be accounted for on the basis of a second-order electrostrictive effect. The electrostrictive constants involved were evaluated and using these constants, the measured electromechanical coupling factors for the four modes were determined; these compare well with the calculated values. A theoretical explanation of this effect is given which depends on the fact that when a given domain becomes ferro-electric it loses its cubic structure and becomes tetragonal. In this process it expands one percent along the tetragonal axis and contracts one-half percent along the other two axes. In the ceramic piece all directions for the tetragonal axis are equally probable, but a applied field can cause the domains in the direction of the field to grow at the expense of domains perpendicular to the field. This growth is accompanied by an increase in the thickness of the crystal and a decrease in radial dimensions. Experimental measurements of the electrostrictive effect are given, and it is shown that the displacement is proportional to the square or products of the electric displacements in the ceramic.

1780 Stabilization of Zirconia, by Jacques Pierrey. Comptes Rendus 226, p. 1729-1731, 1948. (In French)

The effect of MgO, CaO, BeO, and CeO_2 on the stability of ZrO_2 above 1000° was studied. The transformation temperatures (T), that is, the temperature at which the monoclinic form contracts to the tetragonal fragile form, are listed for the different additions. For MgO (1%, fused) T is 900°; for MgO (3-5%, fused and fritted) T is suppressed; for CaO (1%, fused) T is 850°; for CaO (3%, fritted) T is approximately 1500°; for CaO (3-5%, fused) T is suppressed; for BeO (1-5%, fritted) T is 1050-1090°; for CeO_2 (5-13.4%, fritted) T is 700-950°.

CHEMISTRY, ANALYTICAL

1781 The Separation of Zirconium and Hafnium by Extraction with Thenoyltrifluoroacetone, by E. H. Huffman and L. J. Beaufait. AECD-2387 (UCRL-194), October 7, 1948, decl. November 10, 1948. 12p. For publication in Journal of the American Chemical Society.

Distribution ratios for zirconium and hafnium have been found for extraction from 2 M perchloric acid with thenoyltrifluoroacetone of varying concentration and the equilibrium constants for the extractions determined. Two extractions with 0.025 M thenoyltrifluoroacetone of a solution containing 59% as much zirconium as hafnium yielded 27% of the original hafnium with a content of less than 2% zirconium.

1782 Bibliography: The Analytical Chemistry of Beryllium, by Charles V. Banks, John H. McClure and H. V. Meek. Iowa State College Ames Laboratory Report ISC-29, October, 1948. 25p.

The bibliography includes references to all articles appearing in the literature prior to 1906 as well as those articles abstracted in Chemical Abstracts through June, 1948. It contains 266 references arranged chronologically.

1783 Detection of Vanadium, by M. A. Popov. Zavodskaya Laboratoriya 13, p. 680-682, 1947. (In Russian)

The author describes two methods for detecting V. The first method uses benzidine and aniline solutions and is sensitive to 0.5 γ V is a concentration of 1:35,000. The second method, using α-naphthylamine, is sensitive to 2 γ V in a concentration of 1:25,000.

CHEMISTRY, ANALYTICAL (continued)

1784 Determination of Fluorine in Organic Compounds, by N. B. Chapman, R. Heap and B. C. Saunders. Analyst 73, p. 434-441, August 1948.

Several hundred organic compounds containing fluorine were analyzed successfully by methods described by the authors. The compounds examined were fluorophosphonates, fluoroacetates, and related compounds. Methods of breaking down the organic compound to give quantitative yields of fluoride ions and methods for the fluoride ion concentration determination are given. The procedure used to break down the fluorophosphonates is different from that used for the fluoroacetates. Both, however, yield sodium fluoride as the breakdown product. The best method for determining the quantity of fluoride ions in the product is by precipitation as lead chlorofluoride, PbClF. This compound can be dissolved in dilute nitric acid and the chloride determined by the Volhard method. The equivalent amount of fluorine may then be calculated. 15 references.

1785 Electrolytic and Polarographic Determination of Zinc in Thorium, by James H. Patterson and Charles V. Banks. Analytical Chemistry 20, p. 897-900, October 1948.

Methods for the determination of zinc in thorium-zinc alloys ranging from 20 ppm to 100% zinc are described. An electrolytic method is used for alloys that contain more than 1% zinc. In this procedure the thorium is complexed with citrate, so that it does not interfere with the deposition of zinc. For thorium containing less than 1% zinc, a polarographic method is used. In this method the thorium is complexed with sulfosalicylate. The solution used contains 0.02% gelatin to suppress the zinc maximum and has a pH of 8.5. In both electrolytic and polarographic methods nitrate interferes. 28 references.

1786 Partition Chromatography, by W. O. Kermack. Journal of the Incorporated Brewers' Guild 33, p. 81-84, 1947.

The author reviews the subject of partition chromatography, placing special emphasis on the silica gel column, filter paper, and applications.

1787 Titanium. Polarographic Determination in Clays and Clay Products, by Donald F. Adams. Analytical Chemistry 20, p. 891-895, October 1948.

A procedure for the determination of titanium in titaniferous material was developed, using a polargraphic method. The electrolyte used was 1.0 N sulfuric acid, saturated with sodium oxalate and 8% urea for maximum suppression. Curves show the following: 1) the effect of sulfuric acid, titanium, and iron concentrations on the half-wave potential of titanium; 2) the effect of iron-titanium ratio on diffusion current of titanium; and 3) the effect of titanium concentration on diffusion current, the equation for this linear relationship being $Y = 2.396X$, where Y = diffusion current in microamps and X is millimolar titanium concentration. The optimum range in titanium concentration is from 0.063 to 0.10 millimolar with an ultimate range from about 0.012 to 6.3 millimolar. A comparison is made between the standard titanium curve and calculations based on the Ilkovitch (Collection of Czechoslovak Chemical Communications 6, p. 498, 1934) equation.

1788 Zirconium Determination in the Presence of Interfering Elements, by C. A. Kumins. Analytical Chemistry 19, p.376-377, 1947.

On addition of mandelic acid to solutions of zirconium sulphate or zirconium chloride in diluted hydrochloric acid the zirconium is precipitated quantitatively as white zirconium mandelate. As few elements interfere in the precipitation and the precipitate is easy to handle, this method of precipitation compares favorably with the phosphate method and published methods in which organic reagents are used. The precipitate has a composition nearly corresponding to zirconium tetramandelate. The details of the procedure are given.

CHEMISTRY, GENERAL

1789 The Synthesis of Toluene - 1, 3, 5, -C^{14} and Oxalic Acid-C^{14} From Pyruvic Acid-C^{14}; the Mechanisms of the Reactions, by Dorothy M. Hughes and James C. Reid. AECD-2370 (UCRL-180), September 15, 1948, decl. November 2, 1948. 20p.

A synthesis of toluene labeled with C^{14} in the 1, 3 and 5 positions of the ring is described. Labeled oxalic acid is obtained as a second product. The starting material is pyruvic acid-α-C^{14}; the yields of toluene and of sodium oxalate are 62% and 84%, respectively. Certain aspects of the mechanisms of the reactions involved have been checked by tracer technique, with results consistent, with concepts expressed in literature. The decarboxylation of methyldihydrotrimesic acid by sulfuric acid has been found to proceed by loss of the carboxyl carbon atom as carbon monoxide, not carbon dioxide. The formation of di- and tetrahydrouvitic acids in this reaction is therefore questioned. It is shown that pyruvic acid synthesized from acetyl bromide-1-C^{14} via pyruvonitrile may be contaminated with 50% of radioactive acetic acid.

1790 Titanium Hydride, by W. K. Anderson and A. L. Grunwald. Fairchild Engine and Airplane Corporation Report NEPA-258, April 13, 1948. 32p.

The use of hydrides for shielding has aroused considerable interest. Titanium hydride belongs to the metallic hydride class, its composition is generally a function of temperature and pressure, and its physical and chemical properties are functionally related to the composition. The information contained in this report covers only chemical properties and a few simple physical properties. Fabrication data, preparation, analysis, equilibrium studies with other elements and compounds, and nuclear data are also discussed. 13 references.

1791 The Action of Carbon Disulfide on Beryllium Oxide, by André Chrétien and Pierre Silber. Comptes Rendus 226, p. 2072-2074, 1948. (In French)

Exposing heated beryllium oxide to a stream of dry CS_2 (in nitrogen carrier) revealed that no BeS resulted below 700° in 3 hours. Using 70-100 cc of liquid CS_2, the yields were as follows for one-hour exposures: less than 1% at 800°, 12.9% at 1000°, 29.2% at 1116°, and 49.2% at 1210°. This indicates a 100% conversion at 1325°C for a one-hour exposure.

1792 C^{14} Tracer Studies in the Rearrangements of Unsymmetrical α-Diketones: Phenylglyoxal to Mandelic Acid, by O. Kenton Neville. Journal of the American Chemical Society 70, p. 3499-3502, October 1948.

This article is based on MDDC-1168. An abstract of this document has been listed in Abstracts of Declassified Documents I, p. 654, December 10, 1947.

1793 Complex Formation and Solid Solutions in the Ternary System Potassium Fluoride, Rubidium Fluoride, and Magnesium Fluoride, by E. P. Dergunov and A. G. Bergman. Journal of Physical Chemistry (U.S.S.R.) 22, p. 625-632, 1948. (In Russian)

KF and RbF form a continuous series of solid solutions without a minimum. KF and MgF_2 form 2 compounds, the two eutectics being at 12.5 mol % MgF_2 (785°) and at 68% MgF_2 (1028°). RbF and MgF_2 form two compounds with eutectics at 19% MgF_2 (686°) and at 62.5% MgF_2 (883°). For the ternary system, solid solutions are found of $KMgF_3$ with any amount of $RbMgF_3$, and of K_2MgF_4 with Rb_2MgF_4.

1794 Frontiers in Chemistry. Volume V, Chemical Architecture, by R. E. Burk and O. Grummitt. New York, Interscience Publishers, Inc., 1948. 202 p.

The study and determination of intermolecular forces and the architecture of the molecule are discussed in the fifth volume of a lecture series sponsored by Western Reserve University. The following topics are discussed: (1) applications of molecular geometry in the field reaction mechanism,

CHEMISTRY, GENERAL (continued)

(2) dipole moment, resonance, and molecular structure, (3) structure of coordination compounds, (4) x-ray studies of randomness in different materials, (5) light scattering in polymer solutions, and (6) the nature of inorganic gels.

CONTROL OF ATOMIC ENERGY

1795 An International Bibliography on Atomic Energy; Political, Economic, and Social Aspects, Volume 1 (Rev. ed.). United Nations Atomic Energy Commission, September 10, 1948. 98p. (NP-431)

This is the first of two volumes which, it is believed, constitutes the first attempt to provide a comprehensive international bibliography of the literature on atomic energy. The following sections are included: international control; national control and development; peaceful uses of atomic energy; military uses and defence measures; social, economic, political, and ethical implications; education and journalism; films, filmstrips, recordings, plays, and radioscripts; general description of atomic physics; list of bibliographies; list of journals; and list of national agencies (official) connected with atomic energy.

1796 Control of Atomic Energy, by J. R. Newman and B. S. Miller. New York, McGraw-Hill Book Company, Inc., Whittlesey House Division, 1948. 434 p.

This book studies the underlying philosophy of the Atomic Energy Act and its influence on business and industry. It describes the organization and structure of the Atomic Energy Commission and indicates the general pattern of controls prescribed by Congress. The production and ownership of fissionable materials, radioactive by-products, industrial and commercial uses, patents, research, and military applications are discussed.

1797 The World Federation of Scientific Workers, by J. G. Crowther. Nature 162, p. 644-645, October 23, 1948.

The first general assembly of the World Federation of Scientific Workers was held September 21-25 in the vicinity of Prague. Among the subjects discussed and reported on was "Atomic Energy, Secrecy and Peace." Resolutions were passed which dealt with the control of atomic energy, secrecy in science, the distribution of radioactive isotopes, and various general matters.

CORROSION AND ANTI-CORROSION

1798 High-Temperature Oxidation, by H. M. McCullough. Ohio State University Engineering and Experimental Station News 19, No. 5, p.38-41, 1947.

An account is presented of the study of the mechanism of high-temperature oxidation of metals and alloys.

COSMIC RADIATION

1799 The Energy Distribution in Cosmic-Ray Showers, by James A. Richards, Jr. and L. W. Nordheim. Physical Review 74, p. 1106-1113, November 1, 1948.

The track length distribution f(E)dE in a shower is defined as the total distance traveled by all electrons while in the energy interval dE. It is representative for the average energy distribution in a shower. The present paper obtains by numerical methods the complete functions for electrons as well as for photons in showers of high primary energy. Calculations have been made for air and for lead, down to energies of about 4 Mev. Close approximations to the actual cross sections have been used for all energies and all physically significant processes have been included—radiation, pair production, energy loss through collision, Compton effect, and knock-on electrons. As a special result of importance the high number of low-energy photons that accompany a shower is noted; this was evaluated for the first time.

COSMIC RADIATION (continued)

1800 Further Data Concerning the Variation of Penetrating Showers with Altitude, by John Tinlot. Physical Review 74, p. 1197-1198, November 1, 1948. (Letter to the editor)

Additional data have been obtained confirming previous results (Physical Review 73, p. 1476, 1948) on the altitude variation of the penetrating showers. The data further indicate that the frequency of these showers varies exponentially with atmospheric depth, from sea level to an altitude of 30,000 feet, the highest altitude investigated. A graph is given showing the frequencies of various "events" (multiple coincidence counter discharges of various kinds) at seven different altitudes. The "event" believed to represent the occurrence of penetrating showers most accurately at all altitudes lies on an exponential curve, within the experimental error, at all points. The data indicate that the great majority of the events recorded by the penetrating shower detector are not accompanied by dense atmospheric showers, in contradiction to the conclusions reached by Janossy and Broadbent (Proceedings of the Royal Society 192A, p. 364, 1948). A density of 220 particles per square meter is calculated for an altitude of 14,000 feet by making several simplifying assumptions.

1801 Nuclear Disintegration Caused by Cosmic Radiation at Sea Level (Explosion Nucléaire Provoquée par le Rayonnement Cosmique au Niveau de la Mer), by Henriette Faraggi and Georgette Albouy. Comptes Rendus 227, p. 276-278, July 26, 1948. (In French)

The disintegration of a heavy nucleus into nine fragments under the influence of cosmic radiation at sea level has been observed using an Ilford C_2 plate. Because of the low probability of such an event, it has been only rarely observed (Evans and Griffiths, Nature 159, p. 879, 1947; Morand, Cüer, Edmond, and Moucharafyeh, Comptes Rendus 226, p. 713 and 1008, 1948; Yagoda, Physical Review 73, p. 263, 1948). A diagram of the star and tabulated ranges, energies, and identifications of the particles or radiations producing the nine tracks are given. Three proton tracks were observed corresponding to energies of about 6.2, 10.2, and 10.5 Mev. Five of the tracks were attributed to alpha particles having the following energies: 12.5, 14, 15, and 17.5 Mev. (There were two particles having an energy of 17.5 Mev.) The remaining track was caused by the recoil nucleus. The latter had an atomic number in the neighborhood of selenium or titanium. Since the ratio of protons to neutrons in Ag and Br is about 1.3, the authors conclude that during the disintegration 3 to 8 neutrons having an average energy of about 7 Mev were also emitted. These would be invisible in the emulsion. From energy and momentum considerations it is calculated that the incident particle is probably a neutron; also energetic neutrons are frequently found at low altitudes. From various facts the authors suggest the following sequence of events for the disintegration: the impact of a high energy nucleon caused the splitting of the nucleus into two parts having different excitation energies; the heavier of the two fragments returned to the ground state with the emission of neutrons and protons principally, while the lighter fragment was given off with the emission of alpha rays.

1802 Sea Level Latitude Effect of Cosmic Radiation, by Peter A. Morris, W. F. G. Swann, and H. C. Taylor. Physical Review 74, p. 1102-1105, November 1, 1948.

On a recent voyage from Rio de Janeiro to Boston the vertical intensity of the total and hard components of the cosmic radiation was measured with a Geiger counter telescope apparatus. The percentage alteration in going from the high latitudes to the magnetic equator was found to be 5.32 ± 0.46 percent, 4.46 ± 0.61 percent and 5.04 ± 0.55 percent for the hard component, the soft component, and the total radiation, respectively.

1803 Sidereal Variations of Cosmic Rays, by A. R. Hogg. Nature 162, p. 613, October 16, 1948.

Observed variations in cosmic rays at Canberra which have been made using an ionization chamber are compared with London data previously analyzed by Duperier (Nature 158, p. 96, 1945) using the method of Thompson (Physical Review 55, p. 11, 1939). According to Duperier, the first

COSMIC RADIATION (continued)

harmonic of the apparent solar diurnal variation of cosmic rays has three components, e.g. (1) a mean solar vector M, (2) a vector A, altering the amplitude of M, and (3) a vector P controlling the change of phase of M. Upon comparing A and P values obtained for the two locales, the author concludes that it is preferable to regard the P vector as representing merely an annual change in the phase of the true solar diurnal variation, making the diurnal maximum occur earliest in the spring in both places. In addition it is suggested that in terms of the theory advanced by Compton and Getting (Physical Review 47, p. 819, 1935), cosmic rays have an interstellar rather than an intergalactic origin.

1804 A Study of Cosmic-Ray Bursts, by H. S. Bridge, W. E. Hazen, B. Rossi, and R. W. Williams. Physical Review 74, p. 1083-1102, November 1, 1948.

A "fast" ionization chamber suitable for the investigation of cosmic-ray bursts is described. The operation of the chamber and of the associated electronic circuits is discussed. The nature of the cosmic-ray events responsible for the production of ionization bursts was studied (a) by observing coincidences between several ionization chambers, (b) by analyzing the shape of the ionization pulses, (c) by operating an ionization chamber inside a cloud chamber which was expanded whenever the ionization chamber recorded a pulse. Analysis of the experimental results led to the following conclusions: (1) at mountain altitudes 98 percent of the ionization pulses in an unshielded chamber of the type used are produced by nuclear disintegrations, the remaining 2 percent by air showers; (2) in the nuclear disintegrations, heavily ionizing particles of sufficiently high energy are produced to cause coincidences between neighboring chambers; (3) nuclear disintegrations are produced mainly by non-ionizing rays, which are possibly neutrons, certainly not photons; (4) about 12 inches of lead is necessary to reduce the intensity of the radiation which produces nuclear disintegrations to 1/e times its original value. Over 25 diagrams, curves, and photographs. 19 references.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

1805 Method for Preparing Capillary Tube Samples for Powder X-Ray Diffraction Analysis and Study, by P. J. Hagelston and H. W. Dunn. Carbide and Carbon Chemical Corporation Y-12 Plant Report Y-271, September 20, 1948, 10p.

A method is described for the preparation, assembly, and use of a jig employed to fill fine capillary tubes with powder samples for x-ray diffraction work. The use of this jig (a) enables the filling of capillary tubes with hygroscopic material without many of the usual difficulties in technique, (b) sharply curtails possibility of contamination, and (c) facilitates sample preparation of rare or scarce materials.

1806 Basic Aspects of X-Ray Absorption in Quantitative Diffraction Analysis of Powder Mixtures, by Leroy Alexander and Harold P. Klug. Analytical Chemistry 20, p. 886-889, October, 1948.

The mathematical relationships are developed which are pertinent to the quantitative analysis of powder mixtures for the case of diffraction from the surface of a flat powder specimen. These formulas relate the diffracted intensity to the absorptive properties of the sample. Three important cases are treated: (1) In a mixture of n components in which absorbing power of the unknown is equal to that of the matrix and concentration is proportional to intensity, direct analysis is permitted. (2) In a binary mixture in which absorbing power of the unknown is not equal to that of the diluent and concentration is not proportional to intensity, direct analysis is possible by means of calibration curves prepared from synthetic mixtures. (3) In a mixture of n components in which absorbing power of the unknown is not equal to that of the matrix, the general case, analysis is accomplished by the addition of an internal standard. Concentration is proportional to the ratio of the intensity of a selected reflection from the unknown to the intensity of a reflection from the internal standard.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE (continued)

1807 Crystal Structure of Element 43, by Rose C. L. Mooney. Acta Crystallographica 1, Part 4, p. 161-162, September 1948. (See also MDDC-1429)

Excellent powder diffraction patterns have been obtained from microgram quantities of the long-lived isotopes, Tc^{99}, of element 43. Like rhenium, osmium and ruthenium, technetium crystallizes in the hexagonal close-packed arrangement. The cell, which contains two atoms, has the following dimensions: $a_1 = 2.735 \pm 0.001$ A, $a_3 = 4.388 \pm 0.001$ A, $a_3/a_1 = 1.604$. The calculated density, based on an atomic weight of 99, is 11.497 g cm $^{-3}$ Each atom has twelve neighbors, six at 2.735 A and six at 2.698 A.

1808 Dielectric Permittivity and Its Relation to Temperature in Crystals of the Rutile and Perovskite Type, by G. I. Skanavi. Doklady Akademii Nauk SSSR. 59, p. 231-234, January 11, 1948. (In Russian)

The author criticizes the attempts made by various writers to explain the anomalous dielectric behavior of certain crystals. The first step must be a determination of the inner field. The Born formula should not be applied because it does not discriminate between the local and the average macroscopic fields. On the other hand, the Clausius-Mosotti equation could only be applied, in first approximation, to two-ion crystals like NaCl. The author suggests a preliminary estimation of the inner field, starting from Born's "point" model of the crystal. A closer value may be obtained by applying quantum-mechanical considerations to complex crystals. In these crystals the field created by polarized ions, within the Lorentz' sphere, is not zero, and has a different value for ions of different chemical nature and position in the crystal. The field can be calculated from the known lattice structure, and a general formula for the electron polarization is thus obtained. This formula is then analyzed in order to account for the temperature influence on dielectric permittivity. One of the formulas gives for the approximate electron polarization in rutile:

$$\frac{\epsilon_0 - 1}{\epsilon_0 + 2} = \frac{4\pi n}{3} \frac{\alpha_1 + 2\alpha_2}{1 - \alpha_2 C_{22}}$$

where ϵ_0 is the square of the refractive index, n is the number of molecules per unit volume, subscripts 1 and 2 correspond to titanium and oxygen ions respectively, α is the coefficient of electron polarization, and c is a structural coefficient of the lattice.

1809 The Dipolar Broadening of Magnetic Resonance Lines in Crystals, by J. H. Van Vleck. Physical Review 74, p. 1168-1183, November 1, 1948.

In regular crystals, the width of the absorption lines arising from the magnetic moment of the electron or nucleus is caused primarily by the interaction between the magnetic dipoles. It is prohibitively difficult to determine the precise shape of the absorption line theoretically, but the invariance of the diagonal sum in quantum mechanics permits the calculation of the second moment of the frequency deviation, and hence the r.m.s. line breadth. The latter agrees excellently with the observations of Pake and Purcell on the magnetic absorption of the F nucleus in CaF_2, both in absolute magnitude, and in the dependence on the direction between the magnetic field and the principal cubic axes. The fourth moment was also computed to examine how good an approximation is the conventional assumption of a Gaussian shape. As long as no exchange is present (the nuclear case) the Gaussian model is moderately good. For the 100 direction in a cubic crystal, the theoretical ratio of root mean fourth to root mean square breadth is 1.25. Pake and Purcell's measurements yield 1.24 (Physical Review 74, p. 1184, 1948), while a Gaussian model would require 1.32. The theory is extended to include crystals with two kinds of spin moments (two types of nuclei, or simultaneous nuclear and electronic spin). Coupling between unlike moments is less effective (by a factor 2/3 in the r.m.s. width) than that between like moments in broadening the lines. In the paramagnetic absorption caused by electronic spin, the effect of exchange coupling must be included. This interaction does not contribute to the second moment, but greatly increases the fourth. As a result, the lines are peaked much more sharply than one would compute from the second moment with the Gaussian model for

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE (continued)

line shape. This "exchange narrowing" explains why microwave paramagnetic absorption lines are much narrower than one first conjectures from the amount of dipolar coupling. The theoretical calculations, the comparison with the experiments of Pake and Purcell, and the model of Bloembergen, Purcell, and Pound (Physical Review 70, p. 988, 1946), for r-f absorption in liquids are given.

1810 The Electronic Structure of Solids, by E. E. Schneider. Science Progress 36, p. 614-632, October 1948.

The general pattern of the solid state is discussed in relation to advances in the theory of crystalline solids and recent experimentation with such tools as x-ray diffraction and spectroscopy. In particular electronic conduction and other electronic phenomena are related to the structure of solids. The following topics are treated non-mathematically: the band theory of solids, cohesive forces and solid types, the Fermi-Dirac statistics and metallic conduction, electron transfer, the Hall effect and positive holes, the periodic table and solid types, semi-conductors, color centers in alkali halides and impurity phosphors. A periodic table of the elements is shown in which the elements are classified as metals, semi-metals, and excess or defect semi-conductors. In addition the sign of the Hall coefficient is indicated in cases where it is known.

1811 Hexagonal Slip in Beryllium Crystal, by Lester Tarnopol. Metal Progress 52, p. 391, 1947.

A photograph which shows slip planes forming a perfect hexagon round a Brinell impression in a single crystal of 99.5 + % beryllium is shown.

1312 Indexing Powder Photographs of Tetragonal, Hexagonal and Orthorhombic Crystals, by R. Hesse. Acta Crystallographica 1, Part 4, p. 200-207, September 1948.

A numerical method of indexing x-ray powder photographs without the use of single-crystal data is described. The method leads to a fairly systematic treatment of tetragonal and hexagonal photographs, and has also proved valuable in orthorhombic cases. 9 references.

1813 The Interpretation and Application of Electron-Diffraction 'Kikuchi-Line' Patterns. Part I. The Determination of the Crystal Unit Cell, Its Orientation and the Crystal Symmetry, by H. Wilman. Proceedings of the Physical Society 60, p. 23- 341-360, April 1, 1948.

The interpretation of electron-diffraction Kikuchi-line patterns from single crystals is developed as a powerful independent and general means of determining the crystal lattice type, dimensions and orientation and the Laue symmetry of the atomic arrangement. This aim is realized by a construction of the reciprocal lattice by methods which are described and illustrated. The satisfactory accuracy of the method is due to the relativity precise definitions for the location of the Bragg reflection positions, derived and stated here for the first time, which enable the method to be used even when the crystal lattice constants are large so that the bands are narrow and diffuse-edged, as with rhombic sulphur. The patterns shown also illustrate features of the line intensities, especially the reduction in intensity when the bands pass near the undeflected-beam spot. 24 references.

1814 A New Interpretation of Interstitial Compounds—Metallic Carbides, Nitrides and Oxides of Composition MX, by R. E. Rundle. Acta Crystallographica 1, Part 4, p. 180-187, September 1948.

This article is based on AECD-2146. An abstract of this document is listed in Nuclear Science Abstracts as Abstract I-764.

DEUTERIUM

1815 Additional Rotational Energy Levels of H_2O and D_2O Molecules, by N. Ginsburg. Physical Review 74, p. 1052-1057, November 1, 1948.

DEUTERIUM (continued)

An extension of the pure rotational energy levels for H_2O and D_2O is made in order to obtain new possible microwave transitions. For H_2O the levels are given through J = 14 and for D_2O through J = 15. Additional assignments are made in the previously observed absorption spectra. The Wang secular determinant for the asymmetric rotator is expanded, and equations for the energy levels of J = 12, 13, 14, and 15 are given in terms of the asymmetry parameter.

1816 The Dielectric Properties of Water and Heavy Water, by C. H. Collie, J. B. Hasted and D. M. Ritson. Proceedings of the Physical Society 60, p.145-160, February 1, 1948.

Measurements by a number of different methods of the dielectric constant and loss angle of water and heavy water at three widely separated wavelengths in the region of anomalous dispersion, λ = 10 cm, 3 cm, 1.25 cm, are described. Results show that the Debye equations (Polar Molecules, Chemical Catologue Co., p.92, 1929) are exactly obeyed, there being a single time of relaxation varying with the temperature; the ratios of the relaxation times of water and heavy water are found to be in quantitative agreement with the ratios of the viscosity over a temperature range, suggesting that the re-orientation mechanism in these liquids is the same as that of viscosity. The value of the activation energy of the re-orientation process is discussed. The value of 5.5 found for the optical dielectric constant gives a reasonable result for the dielectric constant of water on the Onsager theory. This theory is discussed and shown in give a relaxation equation of the Debye type of alternating fields. 23 references.

FLUOROCARBONS

1817 Chambers Works Process for the Manufacture of $C_{21}F_{44}$ (Distillation and Blending), by E. I. duPont de Nemours. AECD-2384, January 14, 1945, decl. November 9, 1948. 5p. Informal disposition. Document for sale by AEC.

Liquid phase or vapor phase crude $C_{21}F_{44}$ is air blown (to remove acid) filtered, distilled, blended and drummed. No chemical reactions are involved. Very little is known of the structure or average molecular weight of this product. A yield of 100% of theory is assumed for this process.

1818 Chambers Works Process for the Manufacture of $C_{21}F_{44}$ Vapor Phase Crude (Carbon Tetrachloride Extracted), by E. I. duPont de Nemours. AECD-2385, July 25, 1944, decl. November 9, 1948. 4p. Informal disposition. Document for sale by AEC.

No chemical reactions are involved. Certain hydrogen containing impurities are removed by selective extraction with carbon tetrachloride. The extracted product is distilled up to 200°C to removed CCl_4 and low boiling impurities. A tar and a low grade crude $C_{21}F_{44}$ are recovered from the CCl_4 stripper. An 81% yield of extracted product is obtained based on the weight of crude $C_{21}F_{44}$ (vapor phase, topped) used. 11% more material is recovered as a low grade crude which usually requires second passing. The no value tar amounts to about 6% of the crude weight used.

1819 Chambers Works Process for the Vapor Phase Manufacture of Crude $C_{21}F_{44}$, by E. I. duPont de Nemours. AECD-2386, December 17, 1944, decl. November 9, 1948. 6p. Informal disposition. Document for sale by AEC.

Vaporized Necton 45 oil (approximate formula, $C_{21}H_{44}$), diluted with nitrogen gas, is passed over CoF_3 at 300 - 350°C. Most of the hydrogen in the oil is replaced with fluorine, with the formation of HF and CoF_2. Some decomposition of the oil takes place with the formation of lower boiling fluorocarbons. Fluorine gas is passed over the CoF_2 to reconvert it to CoF_3. The crude $C_{21}F_{44}$ is separated from the lower boiling by-products by distillation. The equations for the reactions are:

$$C_{21}H_{44} + 2xCoF_3 \longrightarrow C_{21}F_xH_{(44-x)} + xHF + 2xCoF_2$$

$$2CoF_2 + F_2 \longrightarrow CoF_3$$

FLUOROCARBONS (continued)

These equations are only approximate as little is known of the composition of the product. The chemical yield is 36% and with a feed of 65 lbs of Necton 45 per run, 86 lbs of $C_{21}F_{44}$ crude are produced. In addition, a recovery of 21.9 lbs (9.2%) fluorocarbon solvent and 8 lbs (3.4%) of low boiling fluorocarbons are obtained as by-products.

1820 Fluorocarbon Vapor Balance, by J. H. Simons, W. H. Pearlson, and W. A. Wilson. Analytical Chemistry 20, p. 983, October 1948.

A device was designed for the room temperature molecular weight measurements of fluorocarbons boiling at 100°C or above. A complete sketch is given of the apparatus, which functions essentially by weighing a glass bob in the fluorocarbon vapor at a constant temperature.

1821 Ultraviolet Spectrum of Fluorinated Benzenes, by H. B. Klevens, J. R. Platt and Lois E. Jacobs. Journal of the American Chemical Society 70, p. 3526-3527, October 1948. (Communication to the editor)

The authors present a comparison of the spectra of perfluorotoluene (103.5° boiling point) and toluene in n-heptane solution. Onsets, maximum molecular extinction coefficients, and the oscillator strengths are given. A blue shift of about 500 cm^{-1} per F is indicated. The blue shifts are probably related to the high ionization potential of atomic fluorine, representing increased ionization potential of the ring system with increased fluorine substitution.

GEOPHYSICS

1822 On the Total Half-Life Period of K^{40}, by T. Graf. Physical Review 74, p. 1199-1200, November 1, 1948. (Letter to the editor)

The total half-life of K^{40} is determined to be $(4.0 \pm 0.5) \times 10^8$ years. To obtain this value the β-decay constant previously determined (Physical Review 74, p. 831, 1948) was combined with recent data of Ahrens and Evans (Physical Review 74, p. 279, 1948) on the Ca^{40}/K^{40} ratio in lepidolites. The value obtained is in close agreement with that predicted by Thompson and Rowlands (Nature 152, p. 103, 1943) and is beleived more accurate than the author's earlier value of $5 \pm 1.5 \times 10^8$ years. Estimates (Ahrens and Evans, Physical Review 74, p. 279, 1948; Gráf, (Physical Review 74, p. 831, 1948) of the heat output of potassium in the past are too conservative. The author estimates that 36 times the present total heat generated by radioactivity in the earth's crust was produced by potassium at the time of the earth's origin, 3.35×10^9 years ago. It is also concluded that the age of potassium and other elements is probably less than 4×10^9 years. The decay scheme of K^{40} is shown.

GRAPHITE

1823 The Vapor Pressure and Heat of Sublimation of Graphite, by L. H. Long. Journal of Chemical Physics 16, p. 1087, November 1948. (Letter to the editor)

The author objects to the results given by Brewer, Gilles, and Jenkins (Journal of Chemical Physics 16, p.797, 1948). It is pointed out that temperatures reported for the positive crater of the carbon arc do not agree at all with the vapor pressure of one atmosphere at 4630°K as reported in the above references. The temperature-pressure relation of Brewer et al also would lead to an impossible melting point. It is believed that graphite possesses a very much higher vapor pressure and a lower heat of sublimation than the authors affirm in their article.

HEALTH PROTECTION

1824 Radiation Hazards in Industry, by Charles R. Williams. Journal of Industrial Hygiene and Toxicology 30, p. 294-299, September 1948.

Although radiation problems are not new, their importance as industrial hazards has awakened widespread interest with the advent of nuclear energy and the increasing production of radioisotopes

HEALTH PROTECTION (continued)

for research and industrial applications. The sources of these hazards are discussed here, and it is pointed out that with most radioactive materials, difficulties arise not from their use, but from their misuse. 9 references.

1825 What Every Medical Officer Should Know about the Atomic Bomb. Part X. Protection against Atomic Bombs. Bulletin of the U. S. Army Medical Department 8, p.511-517, July 1948.

Protection against atomic bombs may be divided into passive defense and active defense. The important effects of the atomic bomb against which protection must be developed are: the blast or shock wave; visible light, ultraviolet, and infrared radiations; nuclear radiation; and psychological effects.

INSTRUMENTS

1826 A Mechanism for Automatic and Manual Control of the Air Velocity at the Window Opening of Fume Hoods, by John Weber, Jr. AECD-2380 (ISC-23), July 1948, decl. November 15, 1948. 10p.

A control was designed which, acting through a damper, maintains positive action, is automatic as well as manual, and is purely mechanical in nature. The device is designed to link kinematically the window sash of a fume hood with the damper in the stack of the hood. A description of the control mechanism and detail drawings are included.

1827 Seal and Gasket Materials for Liquid Nitrogen, by R. O. Hutchison. Carbide and Carbon Chemical Corporation Y-12 Plant Report Y-268, September 22, 1948. 11p.

This experiment was conducted to determine the most suitable materials for a vacuum tight gasket and seal on equipment coming in contact with liquid nitrogen. Aluminum, copper and lead were tested as metal gaskets. Duxseal, lubriseal, glyptal, bouncing putty, silicone rubber, fluorinated hydrocarbons and silicone high vacuum grease were used as seals. A lead gasket with silicone high vacuum grease gave superior results and is recommended for the application described herein.

1828 A DC Voltage Regulator for Moderately High Currents, by J. M. McCrea and D. J. Le Roy. Review of Scientific Instruments 19, p. 692-697, October 1948.

The theory and design is given for a voltage stabilizer capable of supplying a current of several amperes at voltages in the region of 100 volts d.c. The main power requirements are furnished by a 220-volt d.c. line. The circuit incorporates two distinct methods of control, resulting in a large stabilization ratio and a low internal resistance. A complete circuit diagram of the voltage stabilizer is included.

1829 Dynamic Pressure Measurement by Optical Interference, by Willard E. Buck and Walter H. Barkas. Review of Scientific Instruments 19, p. 678-684, October 1948.

A pressure gauge is described in which the displacement of a pressure diaphragm is measured by recording photographically the motion of interference fringes formed by light reflected from the diaphragm and from a adjacent stationary mirror. The instrument is simple, unusually accurate and stable. Some typical observed performances are: frequency range, zero to over ten thousand cps; pressure range, zero to five thousand psi; absolute error, less than one-half percent. Calibration is carried out under static conditions and the response is linear. Presentation of the data is direct and the analysis of the records simple. Other possible applications of the dynamic interferometer principle such as recording the changing dimensions of a crystal under the action of a potential difference or the magnetostriction effect on a body placed in a varying magnetic field are suggested.

INSTRUMENTS (continued)

1830 Electron Microscope and Powder Metallurgy, by Pierre Grivet, Francois Bertein, Henri Bruck, and Jean Robillard. Revue de Métallurgie 45, p. 38-48, 1948. (In French)

The authors present a description of an electron microscope equipped with a Bruck device for continuous variation of the focal length of the focusing coils. A new method is also described for making surface reproductions. The negative is made by evaporation of concentrated collodion solution which is then stripped from the specimen.

1831 Gagetron Solves Many Difficult Liquid Level Measuring Problems. Instrumentation 3, No. 4, p.26, Third quarter 1948.

Many problems involving liquid level measurement and control can be solved by the use of a device, called the Gagetron. Operation of the Gagetron depends principally upon two radiation characteristics of gamma rays, namely: their penetrating power and the fact that their intensity is a function of the distance from their source. By placing a gamma-ray detector on the exterior of the tank, the gamma radiation from a minute quantity of radium salts dissolved in the liquid can be detected and measured. Since radiation losses due to absorption by the vessel wall are constant, the intensity of the gamma radiation as measured by the detector is inversely proportional to the square of the distance between the source and the detector. This method can be used as an indication of liquid level.

1832 Improved Magnetic Alloy for Rectifiers and Amplifiers. Iron Age 162, No. 19, p. 108, November 4, 1948.

A nickel-iron alloy designated as Permenorm 5000-Z eliminates arcing at the contacts of mechanical rectifiers and improves the sinusoidal wave output of magnetic amplifiers. This is described in report PB-93861 issued by the Office of Technical Services, Department of Commerce, Washington. The improved magnetic alloy is produced by magnetic annealing combined with drastic cold reduction. This method may produce equally beneficial results in other magnetic alloys.

1833 Quartz Spring Joly Balance, by Irving Sheft and Sherman Fried. Review of Scientific Instruments 19, p.723-724, October 1948.

This article is based on AECD-2082. An abstract of this document has been listed in Nuclear Science Abstracts as Abstract I-269.

1834 Scientific Instruments, edited by H. J. Cooper. London, Hutchinson's Scientific and Technical Publications, 1946. 293 p. with 269 figures.

The construction and usage of scientific instruments are discussed. Particularly up-to-date are the sections on the electron microscope, the mass spectrograph, and the quartz-controlled clock. The principle subject divisions are: optical instruments, measuring instruments, navigational and surveying instruments, acoustics, calculating machines, hardness indicators, and vacuum tubes.

1835 A Simple Temperature Controller, by J. C. Mouzon. Review of Scientific Instruments 19, p.659-662, October 1948.

A simple electronic temperature controller has been developed which incorporates "proportional" control action. Utilizing a resistance thermometer element, its precision of operation is determined ultimately by the stability of the resistance element and the gain of the amplifier. Its operation is essentially independent of line voltage. A circuit diagram is shown.

1836 Third National Instrument Conference and Exhibit, Ralph H. Müller, Contributing Editor. Analytic Chemistry 20, p. 993, October 1948.

The following papers were among those presented at the third National Instrument Conference and Exhibit held in Convention Hall, Philadelphia, Pennsylvania, September 13-17: Temperature and Pressure Measurements in Rockets, by R. J. Havens; Demonstration of Automatic Control Principles,

INSTRUMENTS (continued)

by Gerald F. Akins; Valve Characteristics and Automatic Control, by J. G. Ziegler and N. B. Nichols; Looking into the Future of Electronics, by Gordon Volkenant; Supervisory Control Systems, by Louis Gess and R. M. Hutchinson; Pneumatic Transmission Time Lags, by Mead Bradner; Instrumentation by and with Controlled Volume Pumps, by Robert T. Sheen; Organized Instrument Engineering, by J. Johnston, Jr.; Bourdon Tubes in 5000 p.s.i. Pressure Transmitters, by O. C. Brewster; Electron Microscopy, by James Hillier; Infrared Instrumentation, by Van Zandt Williams; Physical Principles of Vacuum Measurements and Production, by C. H. Bachman; Radio Spectroscopy, by C. H. Townes; Gas Analysis by the Mass Spectrometer, by A. O. C. Nier; Radioactive Tracer Techniques and Measurements, by L. F. Curtiss; Cathode Ray Oscillograph Developments for Laboratory and Production Use, by C. Berkley.

ISOTOPES

1837 Isotopes Branch Bulletin No. 11, by G. H. Guest. National Research Council of Canada Atomic Energy Project Report CRIB-389, October, 1948. 7p.

This is the second of a series of bulletins containing information of interest to Canadian users of radioisotopes. A table listing 9 radioactive isotopes with their uses is given.

1838 Table of Isotopes, by G. T. Seaborg and I. Perlman. University of California Radiation Laboratory Report UCRL-179, August 1948. 58p.

This table is a complete list of all the artificial and natural radioactive and stable isotopes, together with a number of their important features. Information available to approximately July, 1948 is covered. Atomic numbers and mass numbers, the degree of certainty of each isotopic assignment, the percent abundance of the stable isotopes, the type of radiation emitted, the half-life, the energy of radiation emitted, and the observed nuclear reactions (giving the target element, projectile and outgoing particle) by which the radioactive isotopes are formed are listed in the table. 12 pages of references are given.

1839 An Isotopic Abundance Rule and Its Bearing on the Origin of the Nuclei, by F. C. Frank. Proceedings of the Physical Society 60, p.211, February 1948.

The natural abundances of all stable isotopes of any element of higher atomic number than 43 are of similar magnitude, except when there exist natural isobars of lower atomic number; those that have isobars of lower charge are comparatively rare. The limit at Z = 43 is rather arbitrary; indications of the same type of abundance pattern persist down to Se but are not present among light nuclei. "Of similar magnitude" means, commonly, within a factor of 2; at the worst, within a factor of 11 (Ba^{138}. Ba^{135}). "Comparatively rare" means, generally, between 10 times and 100 times rarer. There are only four actual exceptions, i.e. nuclei which possessing lower charge isobars, are more abundant than one or more of their isotopes which possess none. These are Cd^{110}, Sn^{116}, Nd^{142}, Hg^{198}. Of those isotopes which do not possess lower charge isobars, the heaviest is occasionally rather less abundant than the rest; in all such cases it possesses a higher charge isobar, which is less rare than usual (the four exceptions mentioned are such cases). The isotopic abundance pattern of Xe is particularly interesting, since, in obeying the above rule, it breaks the usual rule that every odd isotope of even atomic number has at least one more abundant adjacent even isotope. The only other exceptions to the latter rule, beyond boron, are Sm^{147}, Sm^{149}, Pt^{196} and U^{235}.

In conjunction with Goldschmidt's estimates (Skrifter Norske Videnskapsad 4, 1937) of the cosmic abundances of the elements, the first rule may be generalized to the form: the total cosmic nuclear abundance at each mass number (above 60) is of the same order of magnitude; where there is more than one stable nucleus of a given mass, the predominantly abundant nucleus at this mass is that of lowest charge, and the others may be much rarer. The only grave exception to the rule in this form is the relative rarity of mass number 185 (Re^{185}, possessing no isobar), by a factor between 100 and 1000. It is suggested that new determinations of the abundance of rhenium, particularly in meteorites,

ISOTOPES (continued)

are called for. The rule in this latter form gives evidence in support of the hypothesis that in the origin of the nuclei, the heavier ones (as distinct from the lighter nuclei whose abundance is known to correspond approximately to a thermodynamic equilibrium) have been built up by a sequence of neutron capture processes. Since the nuclei then assume their final charge chiefly by β-decay, the predominance of the lowest charge isobars is a natural consequence.

1840 The Natural Abundance of Isotopes of Stable Elements, by J. R. White and A. E. Cameron. Physical Review 74, p. 991-1000, November 1, 1948.

This article is based on MDDC-1097 and MDDC-1195. Abstracts of these documents have been listed in Abstracts of Declassified Documents I, p.621, December 1, 1947, and p. 666, December 10, 1947, respectively.

MASS SPECTRA

1841 A Mass Spectrometer for Isotope Analysis, by Einar Lindholm. Arkiv för Matematik, Astronomi och Fysik 34 B, p.1-7, 1948.

A semicircular type mass spectrometer which may be used for biological routine work and for investigating the heavier elements has been constructed at the Physical Institute of Stockholms Hogskola. The instrument is described and diagrams are included. To date the mass spectrometer has been used only for the analysis of carbon in connection with experiments to enrich C^{13} by chemical exchange.

1842 A Simple Recording System for a Mass Spectrometer, by V. H. Dibeler, R. B. Bernstein, and T. I. Taylor. Review of Scientific Instruments 19, p. 719-720, October 1948.

A simple recording system is described which is suitable for many routine observations where extremely high sensitivity is not required; the system has been applied to a Nier-type mass spectrometer. A modified Brown Electronik Strip Chart Recorder provided with a manual shunt selector was connected across the output of a standard FP-54 detector circuit without the use of an amplifier. When a reasonably slow voltage sweep rate was used, little difficulty was encountered in selecting the optimum shunt for a given peak before the top of the peak had been scanned. The unit was found to be satisfactory for routine observations such as are made in kinetic studies of isotope exchange in the hydrocarbons. The detector-recorder unit is shown diagrammatically and a portion of the mass spectrum of n-butane obtained using this apparatus is shown. Mass spectra thus recorded (using a procedure described in detail), show a reproducibility of 3 percent of the intensity of the principal ions.

MESONS (MESOTRONS)

1843 The Photogenic Mesons, by Bernard T. Feld. MIT Laboratory for Nuclear Science and Engineering Technical Report No. 8 (Office of Naval Research Contract), March 26, 1948. 41p.

Investigations are reported of cosmic radiations and associated phenomena made with Ilford emulsions in the H. H. Wills Physical Laboratory at the University of Bristol, England. Part I discusses the physical properties, processings, and observation of tracks in the Ilford emulsion; part II concerns observations and classification of the mesons, range-energy relations in the emulsions, and the determination of mass by multiple scattering. Methods for preparing stock solutions for the processing of Ilford emulsion are given. The titles of 30 publications of group are appended.

1844 Latitude Effect and Meson Decay, by H. D. Rathgeber. Nature 162, p. 303-304, August 21, 1948.

MESONS (MESOTRONS) (continued)

Data have been taken to determine more precisely the magnitude of the "atmospheric latitude effect," i.e., the variation in cosmic ray intensity caused by the differences in the yearly averages of the heights at which mesons are produced at different geographic latitudes. Since the 100-mb layer in which mesons are supposedly produced undergoes seasonal variation in regions where the geomagnetic effect is negligible in comparison, by comparing data taken in such a region with those obtained in regions in which the geomagnetic effect must be considered, it is possible to estimate the proportion of the total latitude effect which is actually due to the "atmospheric latitude effect." Tabulated data are presented from which it is concluded that the atmospheric latitude effect is about 3% of the total cosmic ray intensity or one-third of the total latitude effect between the equator and the knee at sea level. This reduction of the previous estimate of the geomagnetic latitude effect will require a revision of the energy spectrum of primary cosmic rays.

METALLURGY

1845 The Beryllium Industries of Germany and Italy (1939-1945), by H. A. Sloman and C. B. Sawyer. Office of Military Government for Germany (US) Fiat Final Report 522, February 25, 1946. 105p.

This report covers an investigation of the beryllium industry in Germany and Italy over the war period 1939-1945. Full details of the production processes used in the manufacture of beryllium and of its light and heavy metal alloys have been obtained together with many working drawings of plant and equipment. Uses for the metal and its alloys have been investigated both at the production centers and by the interrogation of independent research workers. Details of the total volume of production and its distribution among the various users is shown.

1846 Investigation of the Validity of an Ideal Theory of Elasto-Plasticity for Wrought Aluminum Alloys, by E. G. Thomsen, I. Cornet, I. Lotze, and J. E. Dorn. National Advisory Committee for Aeronautics Technical Note No. 1552, July 1948. 47 p. (NP-269)

The primary purpose of the investigation was to determine the relation between stresses and plastic strains of wrought aluminum alloys for three types of loading, tension, compression, and torsion. A secondary objective was to identify which assumptions of an ideal theory of elasto-plasticity are invalid for these alloys. It was found that the universal stress-strain curves as predicted by the theory were not obtained with wrought aluminum alloys. The observed disagreement between theory and experiment was attributed to the invalidity of the assumptions of isotropy, constancy of volume, continuity of the metal, and linear stress-infinitesimal plastic strain relations. Fair correlation between the theory and experimental facts, however, was obtained with a cast and solution heat-treated R-magnesium alloy which behaved isotropically during plastic deformation. Correlation with some of the aluminum alloys was obtained for the compression and torsion data when shear stresses were plotted as functions of effective strain, but no theoretical justification is available at present for this anomaly.

1847 A Metallurgical Investigation of Five Forged Gas-Turbine Discs of Timken Alloy, by J. W. Freemen, E. E. Reynolds, and A. E. White. National Advisory Committee for Aeronautics Technical Note No. 1531, June 1948. 55p.

It has been found that the properties of heat-resisting alloys are dependent to a large extent on the conditions of fabrication. Because the large size of certain gas-turbine rotors has introduced fabrication procedures for which information is not available, a research program was begun to ascertain the properties of the better alloys in the form of large forging. Tests reported in the paper were made to determine the reproducibility of properties from disc to disc made by different companies and to investigate the effect of various fabrication procedures on the disc properties. The properties of five discs of Timken alloy were determined at room temperature and 1200°F. The tests included short-time tensile, stress-rupture, creep, and hardness along with a metallographic examination of

METALLURGY (continued)

the materials before and after testing. It appears from the data that Timken alloy discs, which are hot-cold-worked after hot-forging and made from different heats by different companies, will have similar properties. The properties of the discs are lower than those obtained from presumable similarly processes bar stock on the basis of tensile and rupture characteristics. Comparison on the basis of rupture strengths of the Timken alloy discs with three other discs previously studies was made.

1848 Production of Beryllia and Beryllium at Degussa Plants, by R. Potvin. British Intelligence Objectives Sub-Committee Final Report No. 158, September 18, 1945. 23p.

Beryllia. Ore mainly from Brazil is sintered with quick lime at 1500°C in a rotary furnace then sulfated, silica removed by addition of glue and filber pressing. Iron sulfate is removed by treatment with hydrogen peroxide and calcium carbonate. The pure beryllium sulphate solution is treated with ammonia; the precipate is filtered, dried and fired immediately at 1000°C in a continuous car kiln to give the technical beryllium oxide or briquetted with fine charcoal and wood tar and then fired as above to give calcined briquettes for chlorination.

Beryllium. Calcined briquettes are placed in a cell between carbon electrodes and come in contact with a stream of chlorine at about 700° - 800°C. The impure beryllium chloride is distilled in a stream of hydrogen which removes practically all iron, silicon and aluminum impurities. The pure chloride, mixed with NaOH and NaCl is then electrolysed in a nickel crucible, acting as a cathode, under a chlorine cover. The anode is a rod of compact graphite (temperature 350° voltage 40-25). The beryllium flakes thus obtained are washed successively with dilute sodium hydroxide and dilute nitric acid, rinsed with water, and dried in a centrifuge.

Beryllium Melting and Casting: Briquetted flakes are premelted in hydrogen in a beryllium oxide crucible at 1400°C. The oxides collected at the top of the ingot are removed. Casting is then performed in a vacuum of 10^{-3} mm Hg.

1849 A Recording Dilatometer for Metallurgical Research, by J. O. Lord. Ohio State University, Engineering and Experimental Station News 19, p.9-11, 1947.

An instrument is described with which dimensional changes can be studied in the temperature range + 2400° to -250°C. The equipment was especially designed for the study of the behavior of metals and alloys at sub-zero temperature.

1850 Recovery of Lithium from Its Various Ores and Salts, by J. B. Cunningham and C. H. Gorski. Bureau of Mines Reports of Investigations No. 4321, 1948. 35p.

Amblygonite was sintered in mixture with gypsum and lime, and the amblygonite-$CaSO_4$ sinter cokes ground and water-leached to recover the Li as Li_2SO_4. The gypsum content of the mixture was seen not to be a critical factor, but the percentage of lime in the mixture must be kept below 15, the maximum recovery of Li being 90%. In the case of Li phosphates, a recovery of 95% was obtained by sintering the salt with gypsum at 650-700°. For spodumene, recovery was 80-85% sintering at 1050-1150°.

1851 Alloying of Metal Powders by Diffusion, by Sidney Weinbaum. Journal of Applied Physics 19, p. 897-900, October 1948.

In the preparation of alloys by sintering metal powders, the alloy is formed by the diffusion of metals into each other. The distribution of metallic powder in space is expressed by means of a triple series; this series is used to obtain the solution of the diffusion equation. The resulting formula gives the concentration of metal as a function of space, time, temperature, and particle size. Sample calculations made for one-to-one atomic proportion nickel-copper alloys are in general agreement with experimental results.

METALLURGY (continued)

1852 Investigation of the Thermit Process for the Preparation of Ferrotitanium, by Kurt Giesen and Wilhelm Dautzenberg. Stahl und Eisen 68, p. 159-161, 1948. (In German)

The effect of Al addition to 44% TiO_2 ore is investigated. Fe, Si, and Mn are almost fully reduced, while Ti is only reduced 62%. An Al addition of 94% theoretical seems most favorable. Preheating to 400° produces maximum yield.

1853 Powdered-Metal Friction Material, by Francis J. Lowey. Mechanical Engineering 70, p. 869-875, November 1948.

The author presents a clear description of the powdered-metal friction materials, their fabrication, operating characteristics, applications, installation, and assembly. Schematic drawings are given of molds, the sintering furnace, and sections of linings, facings, and blocks.

1854 Thorium, by Harvey C. Rentschler, Wm. C. Lilliendahl, and John E. Gray. U. S. Patent 2,446,662, July 27, 1948, assigned to Westinghouse Electric Corp.

Using an argon filled system (2/3 atmosphere) and heating the thoria-calcium mixture to 1400°, a method has been developed for producing pure thorium.

MINERALOGY

1855 Researches on the Radioactivity of a Vosges Granite by the Photographic Method (Recherches sur la Radioactivité d'un Granite des Vosges par la Méthode Photographique), by Arlette Hee. Comptes Rendus 227, p. 356-358, August 2, 1948. (In French)

The radioactivity of a Vosges granite containing pleochroic halos and zircons in close relationship with uranium and thorium has been studied by the photographic method recently employed by Poole and Bremner (Nature 161, p. 884, 1948). A close contact between a thin slab of the granite and an Ilford plate was maintained for several weeks, after which it was possible to locate the zircons, halos, quartz, and feldspar in the sample. The photographic plate thus obtained was used to study the distribution of alpha particle tracks in the gelatin. A greatly magnified direct photograph was used for reference.

Some of the zircons proved to be very active, since many stars and "thickets" of tracks were observed. The complex stars observed seemed to proceed from the zircons having sections perpendicular to the quarternary axis. (The zircons crystallize in the form of a bypyramidal prism having a square base.) However, all of the zircons did not exhibit such activity, some being only slightly active or inactive. It was verified that the pleochroic halos are not associated with the zircons in the granite and are not radioactive. The two important active zircon centers which are found in the surface are made invisible by the halo accompanying each active crystal. Quartz and feldspar were found to contain only rare isolated tracks. The existence of a white region surrounding an active region in the negative plate is in agreement with Joly's belief that the halos in the rock are due to ionization of the substance by alpha rays, although the halos themselves are not radioactive. More extended work will be published later.

NEUTRONS

1856 Neutron-Proton Scattering at 90 Mev, by Keith Brueckner, Walter Hartsough, Evans Hayward, Wilson M. Powell. AECD-2369 (UCRL-178), September 10, 1948, decl. November 2, 1948. 33p.

An experimental measurement of the angular distribution of protons scattered by neutrons in the neutron beam of the 184-inch Berkeley cyclotron has been made with a Wilson cloud chamber with magnetic field. The results show that the scattering is not isotropic in the center of mass system and

NEUTRONS (continued)

that it is not symmetric about 90 degrees. The peak of protons in the forward direction indicates that a certain amount of charge exchange is taking place between the neutron and proton.

1857 Capture Cross Sections for Fast Neutrons, by D. J. Hughes, W. B. Spatz, and N. Goldstein. AECD-2371 (ANL-HDY-598), August 1948, decl. November 3, 1948. 29p. For publication in Physical Review. (See also MDDC-27)

This is a more detailed account of work already declassified as MDDC-27. It was the purpose of the present measurements to isolate a particular group of fast neutrons, the nascent fission neutrons of energy about one Mev, and use them for measurement of absorption cross sections. Although the fission neutrons themselves show a large spread of energy, the measured cross sections can be correctly interpreted because of the smooth variation of cross-section with energy. Unmoderated fission neutrons were obtained by irradiating a plate of uranium metal in a beam of slow neutrons from the thermal column of the Argonne heavy water pile. A foil placed inside heavy Cd near such a plate receives only unmoderated fission neutrons if all slowing down materials are carefully excluded.

The procedure is to activate a cadmium covered foil of the material of interest with fission neutrons while an identical bare foil is simultaneously activated with thermal (plus fission) neutrons. The two foils are then counted on a GM Counter. The fast activation cross-section is obtained directly from the counting rate ratio, the known thermal cross section for the particular activity detected, and the calculated ratio of fast to slow flux at the plate (which is approximately unity). In this way no corrections are necessary for self absorption in the foil, complicated decay schemes, or efficiency of the counter. A table is given listing the half-life, thermal activation cross-section, and fast activation cross-section for isotopes ranging in mass from Na^{23} through Bi^{209}.

1858 Recoil Bromine Atoms from Gaseous Ethyl Bromide on Neutron Capture, by T. H. Davies and Sol Wexler. AECD-2374 (ANL-HDY-597), June 1, 1948, decl. November 4, 1948. 61p. Document for sale by AEC.

The present investigation deals mainly with neutron capture by Br^{79} to give the nuclearly excited Br^{80*} of 4.4 hour half life. Ethyl bromide has been selected as the gaseous target in an attempt to determine the nature of bond rupture in an n, γ reaction. It has the advantage of a high vapor pressure ($P_{20°C}$ = 38.6 cm) at room temperature. Thus, small amounts of volatile bromine impurities are of small consequence. The half lives of the two activities formed in radiative capture by both Br^{79} and Br^{81} are convenient for experimental purposes and the neutron capture cross sections sufficiently large. Consideration is given to the recoil energy from radiative neutron capture by Br^{79}, the mean free path of recoil bromine fragments, the distribution of recoil bromine atoms between central rod and wall of the apparatus, and the relative numbers of neutral, anionic, and cationic recoil fragments.

1859 Total Neutron Cross Sections of Compounds with Different Crystalline Structures, by L. Winsberg, D. Meneghetti and S. S. Sidhu. AECD-2378 (ANL-HDY-596), August 1948, decl. November 5, 1948. 14p. For publication in Physical Review. Document for sale by AEC.

An abstract of this document was assigned the number MDDC-1735 (ANL-HDY-401). The abstract was reproduced in its entirety in Abstracts of Declassified Documents 2, p. 171, March 15, 1948.

1860 The Energy Spectrum of the Delayed Neutrons from O^{17}, by Evans Hayward. AECD-2379 (UCRL-195), October 19, 1948, decl. November 16, 1948. For publication in Physical Review. Document for sale by AEC.

The object of this investigation was to determine the neutron energy spectrum from the ranges of the knock-on protons in a hydrogen-filled cloud chamber. Experimental procedure is described. The ranges of all the protons produced by neutrons having energies greater than 0.5 Mev have been measured. The proton ranges were measured to 1 mm. This gives an error in the neutron energy

NEUTRONS (continued)

which is small compared to that caused by the errors in measuring the angles. Tracks of all ages have been included. The energy distributions of 391 recoil protons and of the neutrons producing them, both before and after correction for the variation of the scattering cross section with energy, are given. It is pointed out that there are proton recoils with energies as great as 1.7 Mev, so that even if the direction of the incident neutron is unknown, it must in these cases have at least 1.7 Mev. Experimental error cannot account for the large spread in energy; therefore, the experiment leads to the conclusion that this neutron can have any energy between .6 and 1.7 Mev, 1 Mev being its most probable energy.

1861 The Concept of Albedo in Elementary Diffusion Theory, by G. Placzek. MIT Nuclear Science and Engineering Seminar XXXIX, March 13, 1947. 16p. (NP-160)

In dealing with the theory of the one-velocity model of neutron diffusion and in the study of reflector problems the following situation is often encountered: a medium A, in which neutrons are produced, is bounded by a medium B of different properties and which contains no neutron sources. The question then arises whether it is possible to describe medium B simply by a reflection coefficient or albedo and to determine the neutron distribution in medium A from the albedo of medium B, without paying any further attention to this latter medium. A theoretical discussion and determination of the albedo for a number of characteristic cases is presented. The use of albedo in critical size problems is considered. 5 references.

1862 The Physics of Slow Neutrons, by W. H. Watson. National Research Council of Canada, Atomic Energy Project Research Division Report LT-19, Summer 1947. 43p.

In this series of lectures the experimental evidence and the ideas bearing on the physical processes that occur when slow neutrons pass into matter are treated. The physical explanations of atomic processes are considered. The propagation, scattering and absorption of neutrons are represented "optically", as wave phenomena. General ideas regarding wave phenomena are first considered, followed by more detailed consideration of the structure of matter in relation to beams of slow neutrons. Among the topics discussed in detail are waves and cross-sections, resonance processes, the scattering of neutrons by protons (effect of binding on cross-section), magnetic scattering (ortho and para hydrogen, ferro- and para-magnetics), scattering by solid matter (coherent and incoherent scattering, comparison of neutrons with X-rays, inelastic collisions with lattice scattering and capture, neutron spectrometry and transmission of cold neutrons).

1863 Preliminary Report of Measurement of the Angular Distribution of Neutrons from (d,n) Reactions, by C. E. Falk, F. Seitz and E. Creutz. Carnegie Institute of Technology (Office of Naval Research Contract), October 28, 1948. 18p. (NP-454)

This report gives the results of some preliminary experiments on the angular distributions of neutrons from (d,n) reactions. The purpose of the experiments described was to study the angular distribution of neutrons produced by 16 Mev deuterons, bombarding various targets. The relative resulting neutron fluxes were then measured at different angles by means of threshold detectors, which made it possible to study the distributions of various energy groups. Different elements were used as targets in order to study distributions as functions of the atomic weight of the target and the Q value of the reactions. The targets used were $LiBO_2$ ($Li^{6,7}$, $B^{10,11}$), Be^{9}, $Cu^{63,64}$, and Au^{197}.

1864 Reviews of Unclassified Literature, by A. J. Stevens, G. Feick, John H. Pomeroy, Keith Boyer, and C. W. Tittle. MIT Nuclear Science and Engineering Appendix D, n.d. 18p. (NP-164)

The following literature surveys are included: The fission of U^{235} (the energy of neutrons from fission, gamma rays and gamma energy from fission, beta and neutrino energy, delayed neutron energy),

NEUTRONS (continued)

fission of U^{238}, fission of Th^{232}. Electromagnetic methods of separating isotopes (theory of operation, advantages of the mass-spectrographic method, engineering difficulties, rate of production of separated isotopes, bibliography on the mass spectrometer. The number of secondary neutrons per fission and their energy distribution (number of secondary neutrons per fission of uranium, secondary neutrons from thorium, energy spectrum of secondary neutrons. References are given for each section.

1865 Scattering of Gamma Rays and Neutrons, by M. S. Plesset. Douglas Aircraft Company Project Rand Report RAD-196, April 29, 1947. 56p.

Formulas are developed for the intensity of gamma rays scattered by air from a source to a receiver; only single scattering is considered. Similar calculations are made for the intensity of neutrons singly scattered by air from a source to a receiver. If a shadow shield is supposed to eliminate all direct radiation from the source to the receiver, the shadow shield location affects the regions from which radiation may be scattered into the receiver; this effect is illustrated by comparison of the scattered intensity for a shadow shield adjacent to the receiver. Approximate expressions are given for the reflection of gamma rays and neutrons from a semi-infinite slab (e.g., the ground), and the intensity of gamma rays and neutrons reflected from a source into a receiver is expressed in terms of the source-receiver distance and their height above the ground. Since radiological practice measures gamma ray and neutron fluxes in terms of the ionization produced by them in air chambers, a brief discussion is given of the relation between the flux incident upon an air chamber and the rate of charge production (in esu) in the chamber.

1866 A Quantitative Determination of the Magnetic Moment of the Neutron in Units of the Proton Moment, by F. Bloch, D. Nicodemus, and H. H. Staub. Physical Review 74, p. 1025-1045, November 1, 1948.

A precision determination of the ratio of the magnetic moments of neutron and proton is presented. The method consists in determining the Larmor precession frequencies of neutrons and protons simultaneously in the same extremely homogeneous magnetic field. In this manner the ratio of the two Larmor frequencies gives directly the ratio of the two magnetic moments. The precession frequency of the neutrons is obtained by the occurrence of non-adiabatic transitions of a polarized neutron beam; the precession frequency of the protons is obtained by nuclear induction. Measurements are made so that only small differences in frequency have to be measured in terms of a constant but otherwise unknown standard. The value of the ratio of the two moments is found to be $\mu_N/\mu_P = 0.685001 \pm 0.00003$. By use of this value in conjunction with the recent determination of the ratio of the moments of proton and deuteron by Bloch, Levinthal, and Packard (Physical Review 72, p. 1125, 1947) the deviation of the deuteron moment from additivity is found to be 0.02230 ± 0.00009 nuclear magnetons. 12 figures; 25 references.

NUCLEAR PHYSICS - METHODS OF MEASURING

1867 Description and Instructions for Q-762 [a Revised Higinbotham] Scale of 64, by C. G. Goss and K. N. Forrestal. Oak Ridge National Laboratory Report ORNL-186, October 28, 1948. 9p.

The Q-762 scale of 64 is designed, primarily, to be used with counting tubes operating in the Geiger region, but dependable operation is obtained for other purposes within its design limitations. It features a 6AK5 cathode-follower-preamplifier at the glass G.M. tube, a 6SN7 Schmitt trigger-input-circuit with a pulse height selector, a 6BG6-G shunt regulated, high voltage supply, unregulated B-plus supply, Higinbotham scaling stages, and a 230 volt d.c., resettable, panel-mount Wizard register driven by a 6SN7 tube. A 6J6 difference amplifier is used with mica-window G.M. tubes, because, since the pulse height is a function of anode length, they produce smaller pulses than the conventionally used glass and brass tubes.

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

1868 A Microwave Gas Discharge Counter for the Detection of Ionizing Radiation, by Sanborn C. Brown and John J. McCarthy. MIT Research Laboratory of Electronics Technical Report No. 75 (Army Signal Corp Contract), July 29, 1948. 19p. (NP-446)

Characteristics of a gamma-ray counter making use of a 3000-Mc gas discharge in a coaxial-node cavity resonator are described. The breakdown of a discharge in gases at these frequencies does not depend upon secondary effects. Since the breakdown is not controlled by positive ions, shorter breakdown and resolving times than those of a Geiger-Müller counter are realized. In the high-frequency discharge, ambipolar diffusion is the controlling factor in loss of electrons. A d-c clearing field is superimposed on the a-c field to eliminate electrons rapidly. A quenching agent is present to suppress electron emission from positive-ion bombardment of the walls. The discharge is extinguished by reducing the magnetron power electronically. The plateau and sensitivity characteristics are similar to those of a Geiger-Müller counter.

1869 Predetermined Electronic Counter, by Ben R. Gossick. Fairchild Engine and Airplane Corporation Report NEPA-635, June 21, 1948. 7p.

This counting circuit gives one output pulse for any given integral number on input pulses. Thus it can be used as a scaling device for radiation particle counters. In its simplest form, it consists of a chain of multivibrators connected in cascade. Proof is given that the natural count can be altered to include any integer by the appropriate feedback connections. As examples, two different sets of feedback connections are given for each integer between 2^{n-1} and 2^n.

1870 Coincidence Circuit of Medium Resolution, by H. L. Schultz and Ernest Pollard. Review of Scientific Instruments 19, p. 617-620, October 1948.

A reliable coincidence circuit of medium resolution with resolving time adjustable between 0.4 and 0.01 microsecond is described. The circuit uses a biased-diode pulse level selector in either channel, followed by a triggered blocking oscillator. Narrow pulses of constant shape thus produced in the channels actuate a coincidence tube, the output of which keys a rectangular pulse generator for turning on a power tube connected to a mechanical impulse recorder. Preliminary applications to the study of time fluctuations and delays in proportional counters, and to proton time of flight measurements, are described.

1871 A Counter for Low Energy Ionizing Particles, by H. C. Thomas and N. Underwood. Review of Scientific Instruments 19, p.637-639, October 1948.

A counter which combines large solid angle, low operating voltage, ease of changing source, and ability to detect particles of very low energy is described. By means of a revolving plate a sample may be rotated to a position inside the counting chamber through which helium is slowly passing. A large solid angle with low operating voltage is achieved by placing side by side several semicylindrical cathodes whose central wires are electrically connected. Fe^{55}, which has a half-life of four years, was used as a sample with which to examine the operational characteristics of the counter. A photograph showing the counter design is included.

1872 Development of Thick Emulsions by a Two-Bath Method, by M. Blau and J. A. De Felice. Physical Review 74, p. 1198, November 1, 1948. (Letter to the editor)

A technique for the uniform development of thick emulsions which has been adapted from a method described by Crabtree, Parker, and Russell (Journal of the Society of Motion Picture Engineers 21, p. 21, 1933) is discussed. The method, which was used for Ilford, C2, 200 u plates by the author, is probably applicable to even thicker emulsions. The developer is divided into two baths, the second of which contains alkali in addition to the ordinary developer constituents. Solution compositions and the procedure giving the best results are given in detail. The plates obtained appeared to be uniformly developed throughout the emulsion and proton tracks in the emulsion showed their normal grain density. No reticulation was observed.

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

1873 Instruments and Techniques, by L. Yaffe. Proceedings of the Conference on Nuclear Chemistry, Part I, p. 78-92, Ottawa, Chemical Institute of Canada, 1947.

The instruments and techniques used in the separation, detection and measurement of radioactive materials are reviewed. Two types of instruments are usually used - the counter which responds to individual pulses, and integrating instruments. Some general methods for the preparations of sources and details of measurement in the estimation of alpha, beta and gamma activities are given. The production and measurement of neutrons in a laboratory, as distinct from the pile, are also discussed.

1874 A New Technique for the Measurement of Curvature and Angle of Scattering of Cloud Chamber Trajectories (Neues Verfahren zur Messung von Krummung und Streuwinkeln von Nibelkammerbahnen), by J. Ruling and H. Gheri. Experientia 4, p. 348-351, September 15, 1948. (In German)

A method is described for determining the radius of curvature of the tracks produced by ionizing particles in a cloud chamber. This method allows the recognization of impacts at angles larger than one degree suffered by the particle in the cloud chamber. The magnitude of the scattering angle can also be determined. It is shown, moreover, that the sum of the squares of the angles of scattering (for unit of length, calculated from the measured angles) is larger by a factor of 10-100 than the one calculated according to theory.

1875 A Novel Expansion Ratio Control for Wilson Cloud Chambers, by A. M. C. Helmer. Review of Scientific Instruments 19, p. 723, October 1948.

A method of controlling the expansion ratio in a cloud chamber which undergoes pneumatic expansion is diagrammed and explained. The expansion is operated by a loose rubber diaphragm; the position of the latter is defined in the case of compression by the copper grid and in the case of expansion by a second rubber diaphragm. Additional air pressure may be applied between the second diaphragm and the iron backplate to control the expansion ratio. The design has the advantage that, although the expansion is rapid, the last fraction of the expansion will be slow, providing an opportunity for droplet growth without the formation of spurious droplets.

1876 The Production of Thin Be Foils, by Hugh Bradner. Review of Scientific Instruments 19, p. 662-664, October 1948. (See also AECD-1949)

A procedure for making Be foils between 10^{-5} cm and 10^{-3} cm thick, and with diameters up to an inch and a half, is described, and methods of mounting these foils are indicated. Such foils have proved useful as thin targets, target supports, thin windows, etc. The Be was evaporated in vacuum and the methods used in overcoming the following problems are described: (a) obtaining reproducible quantities of evaporated Be, (b) stripping of the Be from metallic collector plate; (c) preventing curl of the foils when they were stripped; and (d) mounting the foils. Tabulated data on representative runs are shown. The thinnest foils made by the evaporation process were 5.9×10^{-6} inches, or approximately 0.02 mg per square centimeter.

1877 Quantitative Autoradiography (Quantitative Autoradiographie), by K. Zuber. Helvetica Physica Acta 21, p. 365-374, 1948. (In German)

The author has thoroughly examined the question of how far autoradiography may be used quantitatively and has discussed the circumstances under which this method is better suited for the determination of neutron distribution than the method using activation followed by counters. He finds that autoradiography is preferable in the case of a radioactive substance of small dimension, emitting a small number of β-rays per second, but having enough β-rays to have a photographic effect. (That is, the half-life must be large.) From the photographic effect of β-rays from Au^{198} on x-ray film, it is seen that the reciprocity law holds approximately. Pictures of activated gold pieces are shown. A half-life value of 2.77 ± 0.06 days was determined by autoradiography. By using a number of films on both sides of the activated substance, several pictures are obtained and the absorption coefficient for β-rays may be determined. For β-rays from Au^{198}, a value of 21.1 cm^2/g was determined.

NUCLEAR PHYSICS - METHODS OF MEASURING (continued)

1878 Routine Use of Ionization Chamber Method for C^{14} Assay, by C. D. Janney and B. J. Moyer. Review of Scientific Instruments 19, p. 667-674, October 1948. (See also MDDC-1303 and -621)

The design and routine use of apparatus for the measurement of amounts of C^{14} down to a specific activity of the order of 10^{-9} curie per gram is described. Use is made of an ionization chamber containing the sample to be analyzed (as CO_2) and a Lindemann electrometer. The auxiliary electrometer circuits and the apparatus for handling the CO_2 gas are also presented. The method is in regular use in the radiation laboratory for the routine analysis of samples obtained from biological tracer experiments. A comparison with other methods of C^{14} detection is included.

1879 Some Experiments with Adjustable Geiger-Müller Counters, by Mohammed Chaudhri and A. G. Fenton. Proceedings of the Physical Society 60, p.183-193, February 1948.

Special counters are described in which it is possible to alter the effective length as well as the material and diameter of the anode without opening them. This is a distinct advantage in that the effects of these factors on the counter characteristics can be studied without complication due to changes in the gas filling and the nature of the cathode surface brought about by opening the counters or by making separate counters with anodes of different diameters. It was observed that, while in a given counter the anode material and the nature of its surface have little or nothing to do with the characteristics, there is an optimum anode diameter for which the best plateaux are obtained, a factor of obvious practical importance in counter design. The photosensitivity to visible light and longer wavelengths caused by high counting rates or by "continuous" discharges was shown to be due to some surface phenomenon on the cathode. It has been shown in a simple manner that the discharge is not localized, but spreads along the length of the counter. It was observed that the plateau length and slope improve at first, but then deteriorate when the effective length of the counter is reduced by shielding the anode wire at both ends with glass capillary tubes. With metal capillaries, however, the plateau characteristics are best when the full length of the cathode is used. 9 references.

1880 What Every Medical Officer Should Know about the Atomic Bomb. Part IX. Essentials of Instrumentation. The Bulletin of the U. S. Army Medical Department 8, p. 504-511, July 1948.

The detection and measurement of high energy radiation depends on the proper use of suitably constructed instruments. Without instruments even intense radiation fields will not be recognized until irreparable damage has been done. The pros and cons of the following radiation detecting instruments are briefly discussed: the Lauritsen electroscope, the dosimeter, the proportional counter, thimble chambers, the condenser gamma meter, the Geiger-Müller counter, the self-quenching counter, and the photographic film meter.

NUCLEAR PROPERTIES

1881 Study of Phase Transitions by Means of Nuclear Magnetic Resonance Phenomena, by Nelson L. Alpert. MIT Research Laboratory of Electronics Technical Report No. 76 (Army Signal Corp Contract), July 31, 1948. 23p. (NP-441)

Although the nuclear magnetic resonance condition generally depends only on the gyromagnetic ratio of the resonanting nuclei, the width and amplitude of the resonance depend critically on the substance containing the resonating nuclei. A basic factor affecting the width is the characteristic flipping time for the substance - i.e., the average time it takes a molecule to change its orientation appreciably. This fact has been applied in a study of a group of molecular solids which exhibit two or more phase in order to investigate the mechanisms of these transitions. Of the two mechanisms proposed, rotational and order-disorder, the former was eliminated in favor of the latter for HCl, HBr, HI, H_2S, and H_2Se, while free molecular rotation is shown to be plausible in CH_4 and CH_3D.

NUCLEAR PROPERTIES (continued)

1882 Calculation of the Ground State of the α-Particle, by Nils Svartholm. Arkiv för Matematik, Astronomi och Fysik 35A, No. 8, p. 1-16, 1948. (In English)

The author uses the spin-exchange forces and the variation-iteration method in obtaining the solution of the integral equation.

1883 Exchange Forces in the Nuclear Three- and Four-Body Problems, by Nils Svartholm. Arkiv för Matematik, Astronomi och Fysik 35A, No. 7, p. 1-7, 1948. (In English)

The author discusses the solution of nuclear integral equations and presents a method of variation of parameters and iterated functions.

1884 Isobaric States of the Nucleon and the Problem of the Deuteron, by A. Kind. Nuovo Cimento 5, p. 1-22, 1948. (In Italian)

A mathematical treatment of the fundamental state of the deuteron is presented on the basis that the nucleon can exist in excited isobaric states of higher spin and charge. A value of 225 Mev is given for the lower limit of isobaric excitation of the nucleon.

1885 Line Shapes in Nuclear Paramagnetism, by G. E. Pake and E. M. Purcell. Physical Review 74, p. 1184-1188, November 1, 1948.

Several methods of describing the width and shape of the resonances characteristic of nuclear paramagnetism are discussed. One use of the so-called "moments" of the shape function is illustrated by an experimental determination of a root mean square line width which is in substantial agreement with a calculation by Van Vleck (Van Vleck and Weisskopf, Reviews of Modern Physics 17, p. 227, 1945). The solutions of the Bloch equations (Physical Review 70, p. 460, 1946), which lead to the Lorentz shape function traditional in the theory of radiation- and collision-broadened lines, are compared with susceptibility curves based on a Gaussian absorption curve. A significant difference between the two dispersion curves serves as a criterion for determining whether or not either of these two shapes closely approximates a given experimental curve, and experimental examples of each are given. For comparison of shape functions, several well-known specializations of the Kronig-Kramers relations are employed.

1886 The Magnetic Moment of H_3 and He_3 by Møller-Rosenfeld-Theory of Nuclear Forces (Das Magnetische Moment von H_3 und He_3 nach der Møller-Rosenfeld-Theorie der Kernkräfte), by Felix Villars and Armin Thellung. Helvetica Physica Acta 21, p. 355-364, 1948. (In German)

Measurements by Bloch and Anderson (Physical Review 71, p. 373, 551, 1947; Physical Review 71, p. 372, 1947) and Anderson and Novick (Physical Review 73, p. 919, 1948) of the magnetic moments of H_3 and He_3 respectively yielded data, the interpretation of which meets difficulties if attempted within the phenomenological theory of the nuclear exchange effect. A correction must yield values which are equal in magnitude but opposite in sign. The exchange moment μ_{exch} is of the form $\mu_{exch}(He_3) = -\mu_{exch}(H_3)$ and the Møller-Rosenfeld theory, which eliminates the static tensor force by superposition of a pseudoscalar field with a vector meson field (the meson masses and binding constants being assumed equal), was used to calculate μ_{exch}. Formulas for the magnetic eigen moments in the ground states for H_3 and He_3 were obtained. The authors conclude that the Møller-Rosenfeld static approximation is not particularly suitable for the interpretation of the experimental data.

1887 Note on the Spins of Nuclei of Mass Number Ten, by M. Goldhaber. Physical Review 74, p. 1194, November 1, 1948. (Letter to the editor)

Previous attempts to explain the long life of Be^{10}, an outstanding obstacle in the construction of a theory of β-emission, are discussed. The Be^{10}, which decays to B^{10} by β-emission, has a half life about 10^9 - 10^{10} times that expected for an allowed transition, while the apparently similar transition from He^6 to Li^6, with a half-life of 0.8 sec, is allowed. Earlier assumptions that Be^{10}, unlike other

NUCLEAR PROPERTIES (continued)

even-even nuclei has a spin I = 4 (instead of zero) or that the β-transmission is forbidden by a selection rule in the case of Be^{10} are described as unsatisfactory. The author suggests an alternative hypothesis, in the light of the discovery by Davis (Physical Review 74, p. 1193, 1948) that Na^{22} (a self-conjugate nucleus like B^{10}) has a spin of 3 and a nuclear magnetic moment of 1.746. It is assumed that B^{10} has a spin of 3, rather than 1 as has been previously assumed. Some consequences of this assumption are the following: (1) B^{10} would have a magnetic moment of 1.794, (2) the measured g-factor value of Millman, Kusch, and Rabi (Physical Review 56, p. 165, 1939) used to determine (1) is compatible with a $^3D_3$ state for B^{10} with only a slight admixture of higher states, (3) the spin of Be^{10} could be assumed to be zero, and the β-transition to be highly forbidden, (4) similarly, C^{10} could have a spin of 1 with β-decay to the B^{10} ground state highly forbidden, and (5) the identification of the Be^8, (obtained by deuteron bombardment of B^{10}) as in the D state, is difficult to interpret for a B^{10} spin of 1 rather than 3. A direct measurement of the spin of B^{10} is now being attempted.

1888 Nuclear Relaxation in Ice at -180°C, by G. E. Pake and H. S. Gutowsky. Physical Review 74, p. 979-980, October 15, 1948. (Letter to the editor)

The spin-lattice relaxation time for protons in ice has been measured at -180°C, using a sample of conductivity water which had been redistilled in quartz. The sample was placed inside a radio-frequency coil which occupied a cavity in a copper block. The assembly was used in conjunction with the permanent magnet apparatus described elsewhere (Journal of Chemical Physics 16, p. 327, 1948). The time necessary for the return to resonance was determined. The maximum "Y" of the dispersion curve derivative has been plotted as a function of time. A smooth curve was obtained of the form: $Y = 390 - 360\exp(-t/T_1)$ in which Y is the peak height of the central maximum of the dispersion curve derivative, t is the number of minutes taken for the return to resonance, and T_1 is the relaxation time of 10 ± 1 minutes. These data were taken with a frequency of 29 mc/sec and a field of 6820 gauss. The relaxation time of 10 minutes thus obtained, although longer than the measured values for several substances at both lower and higher temperatures, falls far short of correlation with the Debye dielectric relaxation time. Theoretical and experimental results obtained by other workers lead the authors to conclude that the measured T_1 is too small by a factor 10^5. Evidently, like most ionic crystals, ice possesses an unexpectedly short relaxation time.

1889 The Nuclear Spin and Magnetic Moment of Na^{22}, by Luther Davis, Jr. Physical Review 74, p. 1193, November 1, 1948. (Letter to the editor)

The atomic beam magnetic resonance method (Kusch, Millman, and Rabi, Physical Review 57, p. 765, 1940), as used by Zacharias (Physical Review 61, p. 270, 1942) to determine nuclear spin and magnetic moment of K^{40}, has been modified to permit similar observations to be made with radioactive nuclei having considerably shorter half-lives. These modifications involve the use of a mass spectrometer for separating the Na^{22} peaks from the large background of Na^{23} and a beryllium copper multistage electron multiplier (Allen, Physical Review 55, p. 967, 1939; Hin Lew, "Hyperfine Structure of Aluminum by Atomic Beam Method", M.I.T. thesis, 1948) for detecting Na^{22}. A sample of NaN_3 which decomposed at 320°C provided an atomic sodium beam. The beam intensity of Na^{22} was naturally small, a few thousand atoms/sec and the radiofrequency transition intensities were less than 100 atoms/sec. The transition intensity is shown as a function of the frequency of the oscillating field for two Na^{22} lines; a $\Delta F = \pm 1$ transition was made in almsot zero field. The results show a nuclear spin of 3 for Na^{22}; a nuclear magnetic moment of 1.746 ± 0.003 nuclear magnetons was obtained using Millman and Kusch's value for the magnetic moment of Na^{23} (Physical Review 58, p. 438, 1940). These values are in agreement with conclusions reached by Good, Peaslee, and Deutsch (Physical Review 69, p. 813, 1946).

1890 Nuclear Spins and Quadrupole Moments of B^{10} and B^{11}, by Walter Gordy, Harold Ring, and Anton B. Burg. Physical Review 74, p. 1191, November 1, 1948. (Letter to the editor)

From microwave absorption measurements on pure rotational transitions of borine carbonyl, the nuclear spin of B^{10} has been determined as 3 and that of B^{11} as 3/2. Comparisons of the observed

NUCLEAR PROPERTIES (continued)

and calculated hyperfine structures for the J = 1—2 transition of $B^{10}H_3CO$ and $B^{11}H_3CO$ are shown which are in close agreement. The assumed spins giving agreement with observed values were 3 and 3/2 for B^{10} and B^{11}, respectively. The nuclear quadrupole coupling for the two boron isotopes was found to be negative for both, that of B^{10} being 2.13 times the value obtained for B^{11} of -1.55 ± 0.08.

1891 On Nuclear Dipole Vibrations, by M. Goldhaber and E. Teller. Physical Review 74, p. 1046-1049, November 1, 1948.

The high frequency resonances recently observed for (γ,n) reactions as well as photo-fission (Baldwin and Klaiber, Physical Review 71, p. 3, 1947; 73, p. 1156, 1948) are interpreted in anology with the "reststrahl frequencies" of polar crystals. The estimated frequencies are in good agreement with the experimental results. An interesting consequence of this interpretation is the conclusion that strong resonance scattering of γ-rays should take place at a frequency characteristic of the scattering nucleus.

NUCLEAR TRANSFORMATION

1892 Mass Spectrographic Assignment of Rubidium Isotopes, by Frederick L. Reynolds, D. G. Karraker, and David H. Templeton. AECD-2373 (UCRL-186), September 29, 1948, decl. November 2, 1948. 6p. For publication as a letter to the editor of Physical Review.

A mass spectrograph has been used to investigate rubidium isotopes produced by bombardment of bromine (ammonium bromide) with helium ions in the Berkeley 60-inch and 184-inch cyclotrons. In each bombardment with 20 to 100 Mev helium ions there was a good yield of rubidium activity with half-life about 6 hours. The rubidium activities were separated from the target material using 20-30 micrograms of inactive rubidium carrier and divided into two portions. One part was further purified and used for decay and absorption measurements. The other major portion was placed on the tungsten filament of the mass spectrograph as the nitrate or chloride. The Rb^+ ions produced by heating this filament were analyzed by the instrument and caught on a photographic plate. The mass scale was fixed by the lines of stable Rb^{85} and Rb^{87}. Lines at masses 81 and 82 were shown to be radioactive both by the photographic transfer technique and by counting with a Geiger counter provided with a narrow slit. With 80 Mev helium ions 5.0 hour Rb^{81} predominated in the mixture, and with 20 Mev helium ions almost pure 6.3-hour Rb^{82} was obtained.

1893 The (α,n) Cross Section of Boron, by R. L. Walker. AECD-2383 (LADC-507), February 27, 1948, decl. November 19, 1948. 18p. For publication in Physical Review. Document for sale by AEC.

The cross section for the $B^{10,11}(\alpha,n)N^{13,14}$ reactions was measured as a function of the alpha particle energy up to an energy of 5.3 Mev. Resonances were observed at alpha particle energies of 1.8, 2.5, 4.2, 4.9 Mev. Poor resolution may explain why certain resonances reported by other investigators were not observed.

1894 Contributions to the Nuclear Processes Induced in Magnesium by Polonium Alpha-Particles, by A. Szalay and Eva Csongor. Physical Review 74, p. 1063-1070, November 1, 1948.

The short-lived Al^{28} isotope was produced by α-particle bombardment of symmetric Mg hemispheres by a central Po source. In addition to investigating the absolute yield and the shape of the excitation function of Al^{28}, the excitation function, quantum energy, absolute yield, and origin of gamma radiations observed for α-energies below 5.3 Mev were studied. The absolute yield of the Mg^{25} (α,p) Al^{28} process was determined as 1.4×10^{-7} transmutations per bombarding α-particle of 5.3 Mev energy. By direct comparison with the ThC″ gamma radiation from a ThC + C′ + C″ preparation of known strength, the absolute yield of the gamma radiation excited by bombardment with full-energy Po α-particles was determined to be 5.2×10^{-7} gamma-quanta/alpha particle. Various possible

NUCLEAR TRANSFORMATION (continued)

processes through which the gamma radiation might originate are discussed. From energy considerations it is concluded that the Mg^{25} (α, n)Si^{28} is the most probable.

1895 Cross Section for the Reaction C^{12} (γ, n)C^{11}, by J. L. Lawson and M. L. Perlman. Physical Review 74, p. 1190-1191, November 1, 1948. (Letter to the editor)

The number of (γ, n) processes per unit time was determined by observing the C^{11} activity from the reaction C^{12} (γ, n)C^{11}, with a Geiger-Müller counter. The reaction was studied after irradiation of pure graphite with x-rays from a betatron operating at 50 and 98 Mev at measured quantum intensities. From these data, cross section values, which are shown in tabular form, were computed. The products of the cross section by the level width of the (γ, n) reaction (for the level at approximately 30 Mev) was determined as 1.48×10^{-25}Mev cm^2 and 1.46×10^{-25}Mev cm^2 for 98 and 50 Mev x-rays, respectively. The uncertainty in the absolute cross section is estimated as $\pm$ 20 percent, although the comparison at the two x-ray energies is probably good to within 5 percent. The fact that the cross sections based on the intensity at 30 Mev are the same with both 50-Mev and 98-Mev x-rays shows that quanta above 50 Mev in energy do not contribute appreciably to the (γ,n) process on C^{12}. This conclusion is independent of absolute pair production cross section, efficiency of pair counting, and corrections applied to the counting data for the C^{11} and probably applied to (γ,n) reactions generally, in view of the fact that relative yields for these at 50 Mev and at 100 Mev follow the same trend (Perlman and Friedlander, Physical Review 74, p. 442, 1948). From a theory put forward by M. Goldhaber and E. Teller (Physical Review 74, p. 1046, 1948), a cross section of about 1-Mev barn is predicted for the reaction Cu^{63}(γ,n) Cu^{62}. The Cu^{63}(γ,n) cross section, deduced from the measured C^{12} (γ,n) cross section by use of the reaction resonance energy (Baldwin and Klaiber, Physical Review 73, p. 1156, 1948), the relative yields of the two reactions (Lawson, to be published), and the relative quantum intensities at the two resonance energies, is 1.5 Mev barns.

1896 Deuteron-Induced Reactions, by D. C. Peaslee. Physical Review 74, p. 1001-1013, November 1, 1948.

A simple semiclassical model is described for the computation of d-p and d-n cross sections. It is found that the stripping process is responsible for practically the entire observed d-p cross section at any bombarding energy E_d. The few available quantitative d-p measurements—for Na^{23}, Co^{59}, Cu^{63}, Br^{81}, and Bi^{209}—agree with curves calculated by assuming that only the stripping process is effective. As E_d increases above the barrier height of the target nucleus, the measured d-p cross sections diminish; this is interpreted as due to effective d-n competition, in which the excited nucleus re-emits a neutron after acquiring one in the d-p stripping process. It is expected that the d-n excitation curves are also predominantly due to the stripping process for incident energies E_d greater than approximately 10 Mev. To compare observed magnitudes with the calculated values, it is necessary to specify as a nuclear parameter the average "sticking probability" of an elementary particle. Comparison of the d-p and d-n stripping processes indicates that for a given target the ratio of the d-p cross section to the d-n cross section will exceed unity at all energies E_d comparable with the Coulomb barrier and the ratio of the d-p to d-n cross sections may approach the ratio of the average "sticking probabilities" for the neutron and proton (which is approximately unity), as E_d approaches infinity.

PARTICLE ACCELERATORS

1897 Betatron Development in Germany, by Malvern J. Gross. Joint Intelligence Objectives Agency Fiat Final Report No. 534, November 28, 1945. 11 p.

Based on information from a number of sources it is well established that there were only two groups in Germany that had completed the construction of betatrons (magnetic induction electron accelerators) to the point of getting them into operation. The largest one of these machines was for an electron acceleration of 15 Mv, and the next largest 6 Mv. Very little experimental work was done with the 15 Mv machine because of the late date at which it was completed – March, 1945. A number of other groups in Germany started the construction of machines for 15 Mv or less, but had not reached the point of operation. In comparison to the limited amount of experimental work, there appears to have been a considerable amount of theoretical speculation on the part of many physicists on the various problems of betatron design. In general, it seems that betatron development in Germany was far behind that in the United States, most of the experimental work having started after Dr. D. W. Kerst's first publication in the Physical Review on the subject.

1898 German Betatrons, by A. T. Starr, K. J. R. Wilkinson, J. D. Craggs, and L. W. Mussel. British Intelligence Objectives Sub-Committee Final Report No. 148, October 16, 1945. 16 p.

By using a half cycle of induction (in place of the usual quartercycle) the iron mass of a 200 Mv betatron was reduced to 35 tons. The flux was expected to reach a maximum of 15000 gausses, the central limb (for the induction field) was to have no air gap, and there was a special magnetic circuit for the guiding field. There were two AC windings and two DC windings, the latter for the biassing necessary in half wave working. The iron circuit was air cooled, and the windings liquid cooled. The frequency was 50 cps. Drawings and papers are listed.

The following technical information about the 10 Mv betatron that was being constructed at the Kaiser Wilhelm Institute is given. A special feature was the provision of separate pole pieces for the doughnut. The installation was planned to be used with supply frequencies varying from 50 to 1000. The poles are of hypermu V was 0.08 mm thick and the main yoke of material 0.3 mm thick. The orbit radius was 20 cm; the pole shoes were composed of laminations, radially arranged which could be tilted to vary the position of the stable orbit. The central pole, which had two air gaps, had a diameter of 26 cm. The injector has a pair of director plates, and the chamber was made of bent glass tube. The target was the back of the injector at present. To expand the field, an auxiliary coil was fed with a pulse of current several microseconds long provided by a multi-electric quenched gap. Brief descriptions are given of other German betatrons.

1899 Electrostatic High Voltage Generators, by Richard H. Ranger. Office of Military Government for Germany (US) Fiat Final Report No. 894, August 11, 1946. 15 p.

A description is given of a small-size high-voltage generator of the electrostatic type. The design of the generator is given as well as a description of the construction difficulties overcome.

1900 Air-Cored Synchroton, by T. R. Kaiser and J. L. Tuck. Nature 162, p. 616-618, October 16, 1948.

A method is described for bringing electrons up to relativistic energies. Although generally applicable, the method is suggested as being of particular value for an air-cored machine since the radial drift of the electrons is limited, the exciting oscillator frequency is constant, and the effect is obtained by blocking off the oscillator at appropriate moments. The frequency of the accelerating radio-frequency field is made an integral multiple of the frequency of revolution of the electrons at injection. If the injection voltage is sufficiently high, a synchronous beam will be obtained, individual electrons oscillating about an equilibrium orbit which expands as the magnetic guide-field is increased. This expansion is permitted until the electron energy reaches a value such that if it were at the inside of the "doughnut" its frequency would be $1/(n-1)$ times that of the applied electric field; the latter is then suppressed until the equilibrium orbit shrinks to the inside. The sequence is repeated until the electron energy reaches the extreme relativistic region, where the machine becomes identical with

PARTICLE ACCELERATORS (continued)

the conventional synchotron. A schematic diagram is shown and tabulated calculations of equilibrium radii and particle energies for a small machine are given for various field strengths. Curves are shown of the resonator voltage, equilibrium orbit radius, and particle energy as functions of the magnetic field and time after injection.

1901 Electrostatic Deflection of a Betatron or Synchrotron Beam, by E. D. Courant and H. A. Bethe. Review of Scientific Instruments 19, p. 632-637, October 1948.

Theoretical bases of an electrostatic deflection scheme for removing the electron beam from a betatron or synchrotron are considered. The deflection is accomplished in two stages: The first stage is an orbit expansion achieved by a sudden decrease of the magnetic field in the orbit region. The electrons move outwards in spirals of increasing pitch; if the orbit radius is 1 meter and the rate of decrease of the magnetic field is one per cent per microsecond, the pitch of the spiral is 1.26 cm at the "neutral position" where Hr has its maximum value. The pitch is proportional to the 3/5 power of the rate of decrease of the field. At the neutral position the beam enters a radial electric field which deflects it outward more sharply. If this field and the magnetic field with it, extend a distance of about a tenth of the orbit radius beyond the orbit, the electrons will be collimated into a beam whose angular divergence is approximately proportional to $(H/E)^{3/4}$ where H is the magnetic field at the orbit and E the electric deflecting field. With H = 10 kilogauss and E = 60 kv/cm, the angular divergence will be of the order of ten degrees. Curves showing the dependence of the angular divergence on E/H and on the distance to which the fields extend are presented.

PHYSICS, GENERAL

1902 The Flow of a Compressible Fluid Past a Circular Arc Profile, by Carl Kaplan. National Advisory Committee for Aeronautics Report No. 794, 26 p. (NP-264)

The Ackeret iteration process is utilized to obtain higher approximations than that of Prandtl and Glauert for the flow of a compressible fluid past a circular arc profile. The procedure is to expand the velocity potential in a power series of the camber coefficient. The first two terms of the development correspond to the Prandtl-Glauert approximation and yield the well-known correction to the circulation about the profile. The second approximation, involving the square of the camber coefficient, improves the velocity and pressure fields but yields no new results with regard to the circulation, since the circulation about the profile is an odd function of the camber coefficient. The third approximation, involving the cube of the camber coefficient, permits the use of higher values of the camber coefficient and furthermore yields an improvement to the Prandtl-Glauert rule with regard to the effect of compressibility on the circulation of the circular arc profile. Numerical examples with tables and graphs illustrate the results of the analysis.

1903 Quarterly Progress Report (October - December, 1947), Cambridge, Mass., MIT Research Laboratory of Electronics (Army Signal Corp Contract), January 15, 1947. 70 p. (NP-137)

Progress on the following projects in the following activities are reported as indicated below.

I. Microwave and physical electronics: high-power magnetron research; conductivity and work functions of oxide cathodes; spectral emissivity of tungsten; electron emission in accelerating and retarding fields; ionization gauge research; properties of cathode-ray tube screens; determination of emission properties of single crystals; traveling-wave amplifier tubes.

II. Microwave physics: Microwave spectroscopy (microwave-frequency bridge, sweep spectrometer); molecular beam research (hyperfine structure of K^{40}, chlorine, hydrogen and Na^{22}; an electron multiplier, molecular beam apparatuses, nuclear quadrupole effects in the molecular beam spectra); low-pressure gas discharges; low-temperature research on helium liquefiers, superconductivity at microwave frequencies, resistivity of normal conductors, adiabatic demagnetization, classification of phase transitions; magnetic nuclear resonance experiments, paramagnetic and ferromagnetic resonance absorption at microwave frequencies.

PHYSICS, GENERAL (continued)

III. Modern electronic techniques applied to physics and engineering: design and construction of a microwave accelerator; an ultrasonics research program (mechanical excitation of second sound in liquid helium II, low-temperature velocity measurements of second sound, high-frequency ultrasonics, ultrasonic absorption in high polymers); development of flash tubes.

IV. Communications and related projects: pulse modulation studies; stabilized oscillator problems; multipath transmission; properties of random noise (statistical properties, effect of transit time on shot noise); synthesis of optimum linear systems (optimum filtering, optimum prediction); response of networks to frequency transients.

V. Miscellaneous problems: electronic differential analyzer; mathematical instrumentation; lacking phenomena in microwave oscillators; electronic potential mapping; investigation of electro-encephalic activity over a wide frequency band; physical limitations of R-F radiating systems; transmission problems for millimeter waves; the scattering of electromagnetic waves; and transient phenomena in waveguides.

1904 Quarterly Progress Report No. 9, January 1-March 31, 1948, by J. A. Stratton et al. MIT Research Laboratory of Electronics (Office of Naval Research Contract), April 15, 1948. 73 p.

Reports are included on physical electronics, microwave gaseous discharges, solid state physics, RF spectroscopy, magnetic nuclear resonance, linear accelerators, magnetron development, traveling-wave tubes, and communication research. Miscellaneous problems include the electronic differential and automatic impedance analyzers, proton-velocity meter, electronic potential mapping, physical limitations of RF radiating systems, mathematical problems, and the scattering of electromagnetic waves- -matrix methods.

1905 Quarterly Progress Report (for April - June 1948). MIT Research Laboratory of Electronics (Army Signal Corps Contract), July 15, 1948. 97 p. (NP-366)

Among the topics reported upon are: Electron Emmission Problems: Thermionic emission from sintered cathode of thoria and tungsten mixture; correlation of pulsed and d-c emission and decay of pulsed emission of oxide-coated cathodes; work functions and conductivity of oxide-coated cathodes; thermionic emission from oxide-coated cathodes under retarding and accelerating fields; determination of the thermionic emission properties of single tungsten crystals by a photometric method. Gas Discharges: Langmuir probe measurements in the mercury arc operating in the transition range between low and high pressures. Experimental Techniques: Spectral emissivity of tungsten; ionization gauge. Microwave Gaseous Discharges. Properties of Matter at Low Temperatures. Helium liquefiers; surface impedance of tin; resistivity of normal conductors; investigation of second sound in liquid helium II; mechanical excitation of second sound in liquid helium; theory of liquid helium. Properties of Matter at Ultrasonic Frequencies. Phase Transitions. Ultrasonic Absorption in Liquids. Molecular Beam Research: Hyper-fine structures and nuclear quadrupole moments of the halogens, and Na^{22}; the generation and detection of a beam of aluminum atoms; a molecularbeam apparatus; theory of nuclear effects in microwave spectra. Magnetic Nuclear Resonance: Measurements of nuclear magnetic moments; studies of phase transitions by means of magnetic nuclear resonance phenomena; circuit improvement. Paramagnetic Ferromagnetic Resonance Absorption. Microwave Spectroscopy. The Linear Accelerator Program. Magnetron Development: Ten megawatt magnetron; ceramic windows; thoria cathodes; mode stability; noise generation in the pre-oscillating magnetron; static space-charge in the plane magnetron and cylindrical magnetron. Travelling-Wave Tubes: three-cm traveling-wave amplifier tubes; seven-cm traveling-wave oscillator. Miscellaneous Problems: Electronic differential analyzer; an impedance function analyzer; proton-velocity meter; electronic potential mapping; physical limitations of r-f radiation systems; scattering of electronic waves; matrix methods; a d-c amplifier.

PHYSICS, GENERAL (continued)

1906 The Adsorptive Binding of Methanol and Ethanol on the Oxides of Silicon, Titanium, Zirconium, and Thorium, by G. F. Hüttig and G. Pietzka. Monatshefte für Chemie und Verwandte Teile anderer Wissenschaften 78, p. 185-192, 1948.

The authors plot adsorption isotherms for methyl alcohol, ethyl alcohol, and CCl_4 on SiO_2, TeO_2, ZrO_2, and ThO_2. The results seem to show that for a given adsorbent the volume of gas required to form a monolayer is independent of the absorbent temperature and that a greater volume of methyl alcohol than of ethyl alcohol is required to form a monolayer. The ratio of the specific rate of absorption to the specific rate of desorption is larger for ethyl alcohol than for methyl alcohol. The value of this ratio decreases with increase in temperature for a given adsorbate and a given adsorbent.

1907 Anomalous Values of the Thermionic Emission Constant, by H. F. Ivey. Physical Review 74, p. 983-984, October 15, 1948. (Letter to the editor).

Recent experiments seem to indicate that there is no anomaly in the value of A, the thermionic emission constant in the Richardson-Dushman equation, as has been previously reported (Zwikker, Physikalische Zeitschrift 30, p. 578, 1929). Various "anomalous" high values of A previously reported for nickel and other metals are discussed along with the explanations which have been advanced to account for these data. The author concludes that in all cases the discrepancies reported were caused by surface impurities. The latest measurements seem to indicate that there is no clean metal with an emission constant greater than the theoretical value.

1908 The Electronic Structure of the Cesium Fluoride Molecule, by B. V. Nekrasov. Doklady Akademii Nauk SSSR 59, p. 255-256, January 11, 1948. (In Russian)

This molecule presents special interest because it is the only binary compound for which the energy of ionization of the metal is lower than the binding energy of the molecule. Therefore, the individual molecule in this case must closely approach the purely ion type of structure. However, if we try to apply to this picture the recently determined parameters of the CsF molecule (nuclear distance and dipole moment), a dipole moment is obtained (for the given nuclear distance) which disagrees considerably with that determined experimentally. A better approximation is obtained by computing the moment from the values of the electron affinities, but it is still unsatisfactory. The discrepancy disappears when the donor function, characteristic of fluorine, is taken into consideration. The individual molecule of CsF is to be represented as possessing one simple bond and one (seven-polar) donor-acceptor bond. For molecules of this type a formula had been suggested by the author which, when applied to the present case, gives for the dipole moment a value (7.1 ± 0.5 D) closely agreeing with that found experimentally (7.3 ± 0.5 D).

1909 Elution Equations for Adsorption and Ion Exchange in Flow Systems, by Nevin K. Hiester and Theodore Vermeulen. Journal of Chemical Physics 16, p. 1087-1089, November 1948. (Letter to the editor)

By extending Thomas' (Annals of the New York Academy of Science 49, p. 161, 1948) method, the authors have derived general kinetic equations for the elution bell (concentration-time curve which displays a maximum) for any fractional extent of previous saturation. These equations may be applied in any regenerative cycle of ion exchange, chromatography, or gas adsorption. A figure is given presenting typical calculated elution curves.

1910 Equilibrium and Velocity of the Sodium-Hydrogen Exchange on Carbonaceous Exchangers in Contact with Chloride Solutions, by Walter Juda and Morris Carron. Journal of the American Chemical Society 70, p. 3295-3310, October 1948.

The carbonaceous exchangers Amberlite IR-100AG, Ionac C-200, Dowex 30, and Zeokarb were tested for the sodium-hydrogen exchange. The equilibrium and velocity of these exchangers in contact with chloride solution were accounted for by relations identical in form, respectively, with a mass action equation and a second order rate equation of simultaneous opposing reactions. The average

PHYSICS, GENERAL (continued)

values of the "concentration" equilibrium constants, $K_{H/Na}$, are 1.25 on Amberlite IR-100AG, 1.20 on Ionac C-200, 1.01 on Dowex 30, and 0.66 on Zeokarb. They were found to be constant to better than 20% over a range of the water phase varying from 0.001 to about 1N. The constant was shown to be proportional to an equilibrium constant expressed in terms of activities, where the proportionality factor is the constant ratio of the hydrogen and sodium ion activity coefficients in the exchanger phase. The exchange velocities are fairly well represented by a second order rate equation, where k and k′ depend somewhat on the ionic strength of the water phase. Tables of the velocity and equilibrium constants for the different materials and concentration versus time curves are given.

1911 Ionic Exchange Equations Derived from Statistical Thermodynamics, by C. Krishnamoorthy, L. E. Davis and R. Overstreet. Science 108, p. 439-440, October 22, 1948.

Using Guggenheim's (Proceedings of the Royal Society 183 A, p. 203, 1944) discussion relating activities of adsorbed species to the number of moles by equations derived from statistical mechanics, the authors obtain equations which can be applied to ionic exchange "adsorption" states. It is assumed that each adsorbed ion is present in a quasi-ideal monolayer, and that the nature of forces or bonds is irrelevant except that the partition function must be independent of the ionic distribution. While this is apparently true for completely dissociated ions, it may not hold for hydrogen. Making the further assumption that each site on the adsorbing surface has four nearest neighboring sites, the authors obtain

$$k_{(A,B)} = \frac{[A]^{r_2}}{[B]^{r_1}} \times [q_1 A + q_2 B + q_3 C + \ldots]^{r_1 - r_2} \times \frac{(B)^{r_1}}{(A)^{r_2}},$$ and for a system containing La, Cs, and H,

$$k_{(La,Cs)} = \frac{[La]}{[Cs]^3} \times [Cs + H + 2La]^2 \times \frac{(Cs)^3}{(La)},$$ where the terms in brackets represent numbers of moles or replaceable ions in the adsorbent phase Z, and terms in parentheses represent "ionic activities" in the aqueous phase; r_1, r_2, r_3, r_4, ... r_n are the valences of the ionic species A, B, C, and D. The second equation was tested experimentally, and a table of results is given.

1912 Ionization of KI, NaI, and CsCl Molecules by Electrons, by N. I. Ionov. Doklady Akademii Nauk SSSR 59, p. 467-469, January 21, 1948. (In Russian)

A determination of ionization data for KI, NaI, and CsCl was made in the following way. A stream of molecules, obtained by heating the salt was passed through an ionization chamber into a gage. The latter consisted of a tungsten filament in a cylindrical collector and was used to determine the relative densities of the molecule stream by means of ionization. Photoelectrons entered the ionization chamber perpendicular to the molecule stream. The ionized molecules were carried away by an electric field to a mass spectrometer. The spectrum showed lines of ionization products of H_2O, including the H_2O^+ ion, which permitted the calibration of the instrument. The results are shown in a table giving, for the observed 10 positive ions, their ionization potentials, intensities of the ion lines, and the probable reactions of ion formation.

1913 Method for Evaluating the Efficacy of Anion Exchangers, by Geza Austerweil. Comptes Rendus 226, p. 799-801, 1948. (In French)

The author determined that in the case of weak insoluble bases used as anion exchangers diluting the solutions effects a removal of fewer total anions. The characteristic constant of the exchanger was derived from the formula, $K^{PH} = 1 + (m - m^1)/m$, m being the amount of chloride taken up at saturation from a solution of known strength. Melamine formaldehyde resin and aminostyrene polymer showed K values of 1.214 and 1.174, respectively.

PHYSICS, GENERAL (continued)

1914 Thermodynamic Functions for Tritium and Tritium Hydride. The Equilibrium of Tritium and Hydrogen with Tritium Hydride. The Dissociation of Tritium and Tritium Hydride, by W. M. Jones. Journal of Chemical Physics 16, p. 1077-1081, November 1948.

This article is based on AECD-1863. An abstract of this document has been listed in Abstracts of Declassified Documents II, p. 269, May 15, 1948.

PHYSICS, NUCLEAR

1915 Fourth Semi-Annual Report. Bartol Research Foundation of the Franklin Institute (Office of Naval Research Contract), September 15, 1948. 79 p. (NP-453)

Information is reported on the following types of cosmic ray experiments: free balloon investigations at high altitudes and allied cosmic ray experiments, and heavily ionizing penetrating particles at 14,200 feet. Also discussed are the excitation function and energy release in the reaction $B^{11}(d,p)B^{12}$, a resistance-stack voltmeter constructed for use with a potentiometer, high intensity ion sources; notes concerning a new Van de Graaff generator, absorption and coincidence studies of the radiations emitted by 31 radioactive nuclei. The following radiation counter studies were made: specific primary ionization measurements, polarization effects in ionization energy loss of fast electrons, and scintillating counting techniques (G-M photon counters). There is also a section devoted to work on development of a linear accelerator.

1916 Course in Nuclear Physics (Kurs i Karnfysik). Sweden, Teknisk Tidskrift, 1948.

This book contains the following chapters: Introduction to Nuclear Physics, by Oskar Klein; Isotopes and Mass Defect, by Carl Reutersward; Isotope Separation, by Erik Hulthen; Nuclear Moment, by Sten von Friesen; Radioactive Ray Absorption, by Njal Hole; Methods of Measuring Radioactive Radiations, by Karl Gustav Malmfors; High Tension in Nuclear Physics Investigations, by K. J. Brostrom; Cyclotrons, Betatrons, and Synchrotrons, by Hugo Atterling; Nuclear Reactions, by Jorgen K. Boggild; Theories of Nuclear Reactions, by Ivar Waller; Excitation Energies of Nuclear Levels, by Roald Tangen; Alpha-, Beta-, and Gamma-Spectra, by Kai Siegbahn; Radioactive Indicators, by George de Hevesy; Radiation Damages and Protection against Radiation, by Sven Benner; Uranium Splitting, by Stefan Rozental; and Work with Atom Bombs in the U. S., by John Tandberg.

1917 The Mid-Twentieth Century Atom, by Martin Davidson. London, Hutchinson's Scientific and Technical Publications, 1948.

The author presents an account of the development of atomic theory, the atom bomb and the possibilities of industrial applications of atomic energy.

1918 Reports from the Conference of the Swedish National Committee for Physics in 1947, by Manne Siegbahn and Erik Hulthen. Arkiv för Matematik Astronomi och Fysik 34 A, p. 1-20, 1948.

Abstracts of the following papers are given: Influence of Cold Working on the Magnetic Atomic Moments in Gold-Chromium and Copper-Manganese Alloys, by Ebbe Kronqvist; Flow-physical Background of Heat Transfer and Evaporation, by Nils Frossling; Stark Effect and New Energy Levels in the Spectrum of Neutral Fluorine, by Kurt Liden; On Thorium Stars in a Photographic Emulsion, by Richard Westöö; Focusing of Charged Particles in Inhomogeneous Magnetic Fields, by Nils Svartholm; The Decay Scheme of Cs^{134}, by Kai Siegbahn; On the Preparation of U^{239} and Np^{239} in Radiochemical Quantities, by Lars Melander; On the β- and γ-Radiation from U^{239} and Np^{239}, by Hilding Slätis; Nuclear Isomerism of Pt, by Njal Hole; The Decay Scheme of Hf^{181}, by Josef Benes, Njal Hole, and Arne Johansson; The Decay Scheme of W^{187}, by Josef Benes, Njal Hole, and Arne Johansson; Preliminary Experiments with an Arc Ion Source for the Cyclotron, by Hugo Atterling; Some Preliminary Notes on An Equipment for Automatic Resonance Control, by Gunnar Lindström; Pulse Counters for

PHYSICS, NUCLEAR (continued)

Geiger-Müller Tubes, by Björn Astrőm; Images from Anomalies in Fission, by Hans von Ubisch: A Short Account of a Neutron Generator, by Gősta Carlson; A Short Account of a van de Graaff Generator, by Olof Beckman; On the Use of the Ionization Gauge in Kinetic Vacuum Systems, by Carl Reuterswård; On the Case of Radiation Equilibrium in General Relativity Theory and its Bearing on the Early Stage of Stellar Evolution, by Oskar Klein; On the Thermodynamical Equilibrium Theory of the Creation of the Elements, by Lars Treffenberg; On the Use of Charge-Conjugated Wave-Functions in the Meson Pair Theory, by Stig Hjalmars; On the Applicability of the Perturbation Method in the Meson Pair Theory, by Olof Brulin; Magnetic Interaction in the Many-electron Problem, by J. Lindhard; On the Slowing Down of Neutrons in a Moderator with an Energy Depending Mean Free Path, by Gunnar Holte; Calculation of the Interaction between two Particles from the Asymptotic Phase, by Carl-Erik Froberg, and Elimination of Divergences in Quantum Electrodynamics by Riesz's Method of Analytic Continuation, by S. Bertil Nilsson.

PHYSICS, THEORETICAL

1919 Classical Analogue of the Quantum Theory of Perturbations, by M. A. Markov. Zhurnal Eksperimental 'noi i Teoreticheskoi Fiziki 18, p. 510-514, 1948. (In Russian)

In the realm of the Hamilton-Jacobi method in classical electrodynamics, a method is developed for the theory of perturbations in which the action function is developed according to small charge. This method represents the classical analogue to the quantum theory of perturbations. In the second approximation of the perturbation theory calculations are made of the proper values of a rapidly moving electron (classical analogue of the quantum formula of J. Waller, Zeitschrift für Physik 62, p. 674, 1930) and the interaction of two rapid electrons (classical analogue of the quantum formula of C. Mőller, Annales de Physique 14, p. 531, 1932).

In the quantum field theory the method of successive approximations, based on the small magnitude of the charge, is widely used. This article shows that a completely analogous method can be developed in the classical theory. In the quantum theory this method leads to a series of difficulties. It is therefore of some interest to investigate from this point of view its classical analogue and to differentiate the actual difficulties of this method from the defects of a given decomposition. The article presents the method in its application to two problems.

1920 New Aspects of the Photon Self-Energy Problem, by Gregor Wentzel. Physical Review 74, p. 1070-1075, November 1, 1948.

A finite but non-vanishing value for the self-energy of the photon, corresponding to a finite rest-mass, can be deduced from the new invariant formulation of quantum electrodynamics developed by Tomonaga (Progress Theor. Phys. 1, p. 27, 1946) and Schwinger, in the e^2 order approximation. The author concludes that the result obtained indicates that the empirical fact that the photon has no rest-mass does not fit naturally into the framework of quantum electrodynamics; the reliability of the predictions of quantum theory in higher order effects is questioned. It is also noted that the pair creation of other charge particles (mesons, protons) is likely to contribut to the proton self-energy. Therefore, the phenomena involving electrons, positrons, and photons only can hardly be expected to be quite independent of the existence and nature of other particles in the higher order effects.

1921 Some Observable Effects of the Quantum-Mechanical Fluctuations of the Electromagnetic Field, by Theodore A. Welton. Physical Review 74, p. 1157-1167, November 1, 1948.

An intuitive explanation is given for the electromagnetic shift of energy levels by calculating the mean square amplitude of oscillation of an electron coupled to the zero-point fluctuations of the electromagnetic field. The resulting disturbance of the charge and current density of the electron gives rise to various observable effects which can be estimated in a simple classical fashion. The effects treated

PHYSICS, THEORETICAL (continued)

are the Lamb shift, the correction of the g-factor for the orbital and spin angular momenta of the electron, and the correction of the Compton scattering cross section at low energies. A simple explanation is also given for the peculiar ultraviolet divergence noticed by Pauli and Fierz (Nuovo Cimento 15, p. 167, 1938) in their treatment of the infra-red paradox.

RADIATION SICKNESS

1922 Absence of Protective Action of Rutin in Anaphylactic and Histamine Shock, by L. W. Roth and I. M. Shepperd. Science 108, p. 410-411, October 15, 1948. (Comments and Communications)

Raiman, Later, and Necheles (Science 106, p. 368, 1947) reported that significant protection was obtained when sensitized guinea pigs were treated with one or two mg (total dose) of rutin 30 to 45 minutes prior to shocking with the sensitizing antigen, but they found no protection by rutin against histamine shock. However, Wilson, Mortarotti, and DeEds (Journal of Pharmacology and Experimental Therapeutics 90, p. 120, 1947) reported a significant reduction in mortality from histamine (LD_{50}) shock, using a higher dose of rutin, and briefly mentioned their inability to demonstrate any protection against anaphylactic shock. The authors repeated the experiments because of these conflicting results but used the LD_{100} dose of histamine and concluded from the agreement of their results with Raiman et al that rutin protection is insignificant when the higher amount of histamine is used. 1 table.

1923 What Every Medical Officer Should Know about the Atomic Bomb. Part V. Fundamentals of Radiation Pathology. Bulletin of the U. S. Army Medical Department 8, p. 357-362, May 1948.

The pathologic effects of radiation are presented by outlining the early and late changes in tissue cells, organ systems, total body irradiation and internal radiation of radioactive materials introduced into the body either accidentally or therapeutically. A table is given which shows the relative radiosensitivities of various body tissues listed in decreasing order.

RADIOACTIVITY

1924 Presence of 0.208 Mev and 0.157 Mev Gamma Ray Lines in a Sample of the Radioisotope Au-198, by Jesse W. M. DuMond. California Institute of Technology Special Report No. 4, April 2, 1948. 4 p. (NP-237)

In a study for the presence of 0.208 Mev and 0.157 Mev gamma ray lines in a sample of the radioisotope Au^{198}, the activated gold sample was turned so that it stood in the source holder of the spectrometer with its flat face instead of its thin edge facing toward the direction of the crystal and counter. This configuration is better adapted to test the radiations for the presence of softer components by filtration methods. Absorption measurements in tin and lead give clear evidence for the presence of a softer component at energies of 0.208 and 0.157 Mev, and indicate that its intensity relative to the hard component is in accord with the expected value of 23% in confirmation with the conclusions of Levy and Grueling. A decay scheme for Au^{198} is given.

1925 Alpha-Ray Spectra of RaC and RaC′, by W. Y. Chang. Physical Review 74, p. 1195, November 1, 1948. (Letter to the editor)

The cyclotron magnet of the α-ray spectrograph was used in conjunction with plates in a study of α-particles from several natural radioactive sources. Tabulated data for RaC and RaC α-particle energies are given along with relative intensities of the lines. A curve showing the α-particle energy distribution of the RaC α-particles is also shown. The values obtained are in close agreement with results obtained by other workers.

RADIOACTIVITY (continued)

1926 Alpha-Ray Spectra of RdTh, ThC, and ThC′, by W. Y. Chang and T. Coor. Physical Review 74, p. 1196, November 1, 1948. (Letter to the editor)

The chemical method used to obtain RdTh, ThC, and ThC′ for studies using the α-ray spectrograph is described. Tabulated values of α-particle energies and relative intensities for these three elements are given. The values are in close agreement with results obtained by previous investigators. A few of the lines found are attributed to contamination, and an investigation using supports of varying atomic number is suggested.

1927 Coincidence Experiments on Sc^{46}, Ga^{72}, Au^{198}, and Rb^{86}, by E. T. Jurney. Physical Review 74, p. 1049-1052, November 1, 1948.

Gamma-gamma- and beta-gamma-coincidences have been investigated in the disintegration of the active isotopes Sc^{46}, Ga^{72}, Au^{198}, and Rb^{86}. Gamma-gamma-correlation was found in Sc^{46} and in Ga^{72} but not in Au^{198} or Rb^{86}. The beta-ray spectra of Sc^{46} and Au^{198} are found to be simple on the basis of beta-gamma-coincidence measurements, while those of Ga^{72} and Rb^{86} are complex. Gamma-ray energies and beta-ray maximum energies were determined by absorption methods.

1928 Decay of Barium-139, by L. R. Shepherd and J. M. Hill, Nature 162, p. 566-567, October 9, 1948. (Letter to the editor)

An investigation of the activities of Ba^{139} was made using a thin lens beta-ray spectrometer. The radioactive isotope was produced by cyclotron bombardment of fused barium nitrate with 7 Mev deuterons. After separation the beta and gamma radiation both decayed with a half-life of 84 ± 1 min, which is close to the value obtained by Cork and Pool of 85 min (Physical Review 51, p. 1010, 1937). The momentum distribution and Fermi plot of the beta spectrum are shown. The latter indicated a maximum beta energy of 2.27 ± 0.02 Mev. Using absorption methods, Kalbfell and Cooley have reported a maximum energy of 1 Mev, accompanied by 0.6 Mev gamma radiation (Physical Review 58, p. 91, 1940), while Born and Seelmann-Eggebert reported a 2.3 Mev value for the beta-ray maximum energy (Naturwissenschaften 31, p. 210, 1943). In addition two conversion electron groups were found having energies of 126 ± 0.5 Kev and 159 ± 2 Kev, corresponding to the K and L electrons from the conversion of a gamma ray of 163 ± 0.5 Kev in the product nucleus. From the momentum distribution curve the estimated ratio of conversion electrons to beta particles is $5 \pm 1\%$ and the ratio N_K/N_L is approximately 6.

The lead absorption curve obtained using a brass gamma counter (and polythene to absorb the β-particles) gives a mass absorption coefficient of 1.38 $cm^2\ gm^{-1}$ corresponding to a 163 Kev gamma ray. About 10% of the counting rate was attributed to a 1.05 ± 0.1 Mev gamma ray. The percentage of conversion electrons estimated from coincidences between β-particles and gamma rays and between β-particles and conversion electrons was in good agreement with the value obtained by the spectrometer. Using equipment with a lower limit of 10^{-7} sec, no measurable metastable life-time could be detected for the product nucleus La^{139}, which has a 7/2 spin in the ground state.

1929 The Dependence of Rate of Radioactive Decay on the State of Chemical Combination. Office of Naval Research European Scientific Notes 2, p. 253-254, September 1, 1948.

Experiments indicate that the rate of conversion of beryllium-7 to lithium-7 by the capture of an orbital electron is changed by as much as one per cent by a change in the state of chemical combination of the beryllium.

1930 The γ-Rays of Thorium CC′, by S. C Fultz and G. N. Harding. Canadian Journal of Research 26 A, p. 313-325, September 1948. (See also NRC-1804)

A value of $.14 \pm .014$ Mev has been determined for the total gamma-ray energy of ThCC′ by measuring coincidences between the gamma rays emitted by ThCC′ and the subsequently emitted alpha particles of ThC′. It is shown that this value favors the level scheme proposed by Ellis (Proceedings

RADIOACTIVITY (continued)

of the Royal Society (London) 143 A, p. 350, 1933), which includes only the gamma rays of energy 0.726 and 1.80 Mev, taking the former as electric quadrupole radiation. Ellis' level scheme is compared with that of Latyschev and Kulchitsky (Journal of Physics U.S.S.R. 4, p. 515, 1941), and nuclear energy level diagrams are shown. The experimental procedures, corrections, and calibrations are discussed in detail, and tabulated data and curves are given for the counter efficiency and gamma-ray energy measurements. The importance of taking bremsstrahlung into account when investigating low intensity gamma-rays by the coincidence method is illustrated by these data. 37 references.

1931 Measurement of Carbon 14, by John D. Roberts, Winifred Bennett, E. W. Holroyd, and C. H. Fugitt. Analytical Chemistry 20, p. 904-905, October 1948.

The authors developed a method for the measurement of radioactivity from C^{14} by converting the samples to barium carbonate and measuring the activity with a modified Lauritsen electroscope. A sketch of the apparatus for precipitation of the radioactive carbon is given. 14 references.

1932 A Search for Gamma-Rays from He^{6} and F^{18}, by William J. Knox. Physical Review 74, p. 1192-1193, November 1, 1948. (Letter to the editor).

This article is based on AECD-2261. An abstract of this document has been listed in Nuclear Science Abstracts as Abstract No. I-1186.

RADIOGRAPHY

1933 Use of Radon for Industrial Radiography, by A. Morrison. Non-Destructive Testing 6, p. 24-26, 1947.

The relative suitabilities of radon and radium for radiography are discussed. When radiographic inspection is continuous radium is most suitable. Radon should be used when it is not practicable to keep radium available or when the cost of keeping a radium source at hand is greater than that of using radon for occasional work. Tables are given for calculating exposure times for radon from those required for radium sources.

RADIOTHERAPY

1934 Clinical Experience in Diagnosis and Treatment of Thyroid Disorders with Radioactive Iodine (Eight-Day Half-Life), by Sidney C. Werner, Edith H. Quimby, and Charlotte Schmidt. Radiology 51, p. 564-578, October 1948.

Tracer studies showed that when the diet has not been deficient in iodine and when stable iodine has not been given a short time before I^{131} is used, I^{131} uptake has a diagnostic value. Normal thyroid uptake of I^{131} was found to be 15 to 30% of an administered tracer dose of 40 to 100 microcuries. Hyperthyroidism is indicated above 40%, while hypothyroidism is indicated below 10%. Thirty cases of unquestioned toxic goiter were treated successfully with 1 or 2 doses of about 125 microcuries of I^{131} per estimated gram weight of the thyroid. Treatment failed in 4 cases and 6 cases did not respond to 1 dose. The causes of failure in this series appear mainly to be inadequate dosage and possibly unusually high basal metabolic rate. Complications following treatment included sore throat, cough, tender gland, flare-up of toxicity, and transient hypothyroidism. 14 references.

1935 Factors Involved in the Experimental Therapy of Metastatic Thyroid Cancer with I^{131}, by L. D. Marinelli, J. B. Trunnell, R. F. Hill, and F. W. Foote. Radiology 51, p. 553-557, October 1948.

A rational basis for the therapy of functional metastatic thyroid cancer depends on many physiological and functional factors which are mostly unknown or difficult to determine with suitable accuracy. Physical calculations and radiological experience provide, however, some broad quantitative data upon which experimental therapy could be based. Particular attention should be paid to the hemopoietic system and to body structures which are bathed by fluids of high I^{131} concentration. Preliminary results warrant further clinical trial of this type of therapy.

RADIOTHERAPY (continued)

One case is described in which satisfactory initial retention of I^{131} in the tumor appeared to justify experimental treatment with massive doses since the patient would soon die without treatment. This was followed by definite improvement until an acute thyrotoxicosis set in. This was controlled by thiouracil and treatment continued. There has been great improvement in the patient although there is still viable neoplastic tissue in his body. 9 references.

1936 Radioactive Iodine Studies of Functional Thyroid Carcinoma, by Virginia Kneeland Frantz, Edith H. Quimby, and Titus C. Evans. Radiology 51, p. 532-552, October 1948.

One hundred and thirty-nine cases of thyroid carcinoma classified by histologic types and treated by traditional therapeutic methods are analyzed statistically. The effects of local postoperative radiotherapy are not evaluated in these cases. A study of 68 cases of possible thyroid carcinoma (32 proved cases) administered tracer and therapeutic doses of I^{131} is given as a preliminary report. Surgical removal of the thyroid to facilitate I^{131} therapy is believed to be a better course than inactivating the gland by massive doses of the isotope except in special circumstances, for inactivation is a time-consuming procedure during which the growth and physiology, and even perhaps the morphology, of the metastatic deposits may change the course of the disease and perhaps the effectiveness of internal radiation by the isotope. 18 references, 12 tables, and 12 figures.

1937 Treatment of Hyperthyroidism with Radioactive Iodine (I^{130}, 12-Hour Half-Life, and I^{131}, 8-Day Half-Life), by Earle M. Chapman, Bengt N. Skanse, and Robley D. Evans. Radiology 51, p. 558-563, October 1948.

Sixty-five patients were treated with I^{130} and another 65 with I^{131}. I^{130} was efficacious in 51 cases in single doses averaging 20 millicuries or 0.45 millicurie per estimated gram of thyroid. Ninety per cent of this dose of radiation is delivered in the first 36 hours. Myxedema was produced in 11 cases, and histologically fibrosis and regenerative hyperplasia were observed 1 and 2 years after treatment. Toxic effects included nausea, slight fever, and swelling and tenderness of the gland. Relapse or recurrence has not taken place. Fifty-two cases responded well to single doses of I^{131} at 0.142 millicurie per estimated gram of thyroid tissue. Ninety-seven per cent of this dose of radiation is delivered in 30 days. Myxedema was produced in 4 cases. There has been no recurrence of the disease. The only histologic study yet available showed edema and separation of the cells from the basement membrane, but no fibrosis. 6 figures, 1 table, and 5 references.

RARE EARTHS

1938 Light Absorption of Solutions of the Tri-Valent Ions of the Lanthanide and Actinide Rare Earths. Part I. The Lighter Lanthanide Elements in Aqueous Perchloric Acid, by D. C. Stewart. AECD-2389 (UCRL-182), September 22, 1948, decl. November 12, 1948. Informal disposition. Document for sale by AEC.

The absorption spectra of the perchlorates of the lighter rare earth elements (lanthanum through terbium, with the exception of promethium) were determined in aqueous solution over a wave length range of 220 to 100 μ; using a Beckman quartz prism spectrophotometer. The values obtained are compared with those available from the literature, and the data are presented graphically to show the change in the molar extinction coefficient of the solutions with change in wave length of the incident light.

1939 Investigations of Rare Earth Problems. University of Illinois Quarterly Progress Report No. 9 (Office of Naval Research Contract), June 1 - September 1, 1948. 26 p. (NP-437)

The preparation of a nearly pure erbium sample from an erbium-yttrium mixture is described; fractional precipitation of the ferrocyanides is presented as a rapid procedure. Numerous attempts at preparing 8-hydroxyquinoline derivatives of the rare earths gave yellow solids which did not analyze

RARE EARTHS (continued)

to any possible compound. The possibility of combining counter-current electromigration with ion exchange was considered for the separation of the lanthanons. A summary of the salient results of the investigation of methods of concentrating praseodymium is presented; a possible new gravimetric method of determining active oxygen in the higher oxide of this element involving the per cent increase in weight upon conversion of the oxide to the trihydroxide, is outlined. A summary and a discussion of all data which have been obtained in an investigation of the phosphoric acid derivatives of the rare earths is given. Experimental techniques involved in rare-earth average-atomic-weight determinations by dihydrogen phosphate and cerate procedures are set forth; comparison of the atomic weight values obtained from these procedures is made with similar data secured from average atomic weight determinations by the standard oxalate method. An investigation of a radiometric method for the determination of thorium in the presence of the rare earths has been started; a brief summary of the course of the investigation is outlined, and the procedures for the preparation of the precipitating agent, disodium dihydrogen-hypophosphate hexahydrate, are discussed.

1940 Determination of Cerium by Means of Oxidation-Reduction Indicators, by G. Charlot. Analytica Chimica Acta 1, p. 309-313, 1947. (In French)

After tests of several indicators N-phenylanthranilic acid is recommended as the best for detection of Ce^{+4}. It is found that o-phenanthroline-ferrous complex is also useful for rare earth detection. The limit of dilution for the Ce was $10^{-5.3}$ g ions per liter.

1941 Isomeric Nuclei of Dysprosium, Rhodium, and Zirconium, by Njål Hole. Arkiv för Matematik, Astronomi och Fysik 36 A, No. 2, 1948. 8 p. (In German)

The investigations reveal that Dy electron emission takes place with a maximum energy of 93 Kev, interpreted as an L-conversion line. The metastable state of Rh^{103} is obtained by a (p,p) process and a (d,pn) process, and also as a daughter product of 41-day Ru. Two components with upper limits of 665 Kev and 350 Kev as well as β-lines with energies of 217 Kev and 290 Kev were found in the β-spectrum of Ru^{103}. Fast neutron bombardment of Zr produces 4.5-min. Zr, with an electron line of 555 Kev.

1942 Titration of Cerium Ions with Permanganate, by G. Goffart. Analytica Chimica Acta 2, p. 140-145, 1948. (In French)

In 25 ml of the unknown solution, about 150 mg of Ce should be contained as nitrate. This quantity of the solution is added to about 200 ml of saturated sodium pyrophosphate solution which has been acidified to a suitable pH with HCl. This mixture is titrated with 0.02M $KMnO_4$ solution. The end-point may be determined potentiometrically, using a polished Pt electrode and a calomel cell, or amperometrically, using a Pt indicating electrode connected through a 1000-ohm resistance to an Ag electrode covered with AgCl. Best results are obtained with the latter method. Only Mn interferes.

SCIENTIFIC RESEARCH AND LABORATORIES

1943 Research Activities of Professor Mokichiro Nogami, by Stuart C. Williams. U. S. Far East Command, October 25, 1947. 6 p. (NP-145)

The investigation was found to concern the following research activities (a) the study of the polarization of the deuteron nucleus in the coulomb field and (b) theoretical research on the role of the so called "damping effect" in the various radiation and collision phenomena in which electrons, protons, mesons and light quanta take part.

1944 Biological Effects of High Energy Radiations, by Richard H. Oppermann. Journal of the Franklin Institute 246, p. 360-361, October 1948. (Current Topics Section)

Dr. Leonard B. Clark, Chairman of the Union College (Schenectady, N.Y.) Department of Biology, will direct the scientific work in a research project to be undertaken by the college for the Office of

SCIENTIFIC RESEARCH AND LABORATORIES (continued)

Naval Research. The project will be financed by the Atomic Energy Commission and will include three subjects of investigation: the relations between biological effects and the wave lengths of x-rays from one million to 100 million volts; the depth dose effect of such x-rays in tissues or tissue-like masses of living organisms such as blocks of compressed yeast cells; and the correlation of different particular physiological processes in the same living cells exposed to x-radiation.

1945 Electronics at Harwell. Wire World p. 323-324, September 1948.

Electronic methods are being applied extensively to the technique of research into the problems of nuclear physics conducted at the Atomic Energy Research Establishment at Harwell. Electronic components of the 200-Mev cyclotron and of the synchrotron are discussed. A Van de Graaff electrostatic generator for 5MV is under test and will be used with a linear accelerator tube for the precise measurement of nuclear reaction energy levels. The two atomic piles rely extensively on electronic monitoring of temperature and neutron density for their safe operation. Electronic techniques have been developed for controlling the operations of radio-chemical analysis, for checking that chemists have washed their hands properly before leaving, and for testing the effluent from the Establishment before it is returned to the Thames.

1946 Industrial Applications of Radioisotopes. Iron Age 162, No. 18, p. 67, October 28, 1948.

According to the Fourth Semiannual Report of the U.S. Atomic Energy Commission more than 300 laboratories in this country and abroad have received and are using radioactive isotopes for research purposes. The availability of radioactive isotopes for use as tracers in industrial research has opened up a number of interesting development projects. Those of special interest in the metal-working field reported in the article include studies of the mechanism of diffusion in metals and material transfer in both dry and lubricated friction.

SPECTROSCOPY

1947 The Band-Spectrum of Beryllium Oxide between λ10,000 A and λ11,600 A, by Albin Lagerqvist. Arkiv för Matematik, Astronomi och Fysik 34 B, p. 1-6, 1948.

In a previous article (Arkiv för Matematik, Astronomi och Fysik 31 A, No. 21, 1945) the author investigated the infra-red $\pi - \Sigma$ system of beryllium oxide between λ8400 A and λ1000 A. In this paper the investigation of the infra-red system has been extended to about λ11600 A. Three new bands are analysed. The numbering of the upper bibrational levels is altered by one unit. The (1, 0) band with origin at λ9647.52 - earlier regarded as the (0, 0) band - is followed up to higher wave-lengths and two perturbations are found there. The other bands analysed are the bands (0, 0), (1, 1) and (3, 2). Their origins are situated at λ10826.63 A, λ11234.56 A and λ10344.70 A. A new band-formula for the origins of the $\pi - \Sigma$ system is worked out.

1948 Establishment of Quantitative Spectrographic Methods of Analysis of Various Raw and Finished Ceramic Materials. Applied Research Laboratories, Glendale, Calif., Interim Quarterly Progress Report No. 7 (Office of Naval Research Contract), March 15, 1948. 12 p.

The optimum conditions for heat treating $CaTiO_3$ and $MgTiO_3$ were investigated. Samples of the compounds were heated at various temperatures in a furnace and the resulting effects on spectrochemical determinations observed. Heat treatment at 1000°C for 30 minutes is recommended for the analysis of $CaTiO_3$ and at 1200°C for 30 minutes for $MgTiO_3$. Work is in progress on the determination of impurities in 20 titanate and TiO standards. Li CO was purified (99.97%) by the use of an ion exchange resin column. This compound is required as a flux in the analysis of titanate samples.

SPECTROSCOPY (Continued)

1949 Producing a Fiduciary Mark on X-Ray Spectrometer Curves, by Jonathan Parsons and S. G. Knoch. Review of Scientific Instruments 19, p. 722, October 1948.

A method of causing an instantaneous dip in the recording trance at a stated position in the scanning arc has been devised for the diffraction spectrometer built in the Applied Physics Research Laboratory at the Ford Motor Company. Such a device is necessary to establish a fiduciary reference point relating the position of the scanning arm to the corresponding chart position in using a direct recording instrument of this type. The device consists of a set of contact points which are installed on the scanning arm and track of the spectrometer arc. When the contact is made during traversal of the arc, a capacitor is placed in parallel with the signal voltage leads to the recorder; the device makes the fiduciary mark independent of the duration time of the contact. By running a calibration curve using a known substance, the exact position of this mark can be determined. With the device described the dip in the curve always occurs at the same diffraction angle. The associated circuit is shown and typical circuit constant values are indicated. As many fixed contacts, wired in parallel, can be used as is convenient for accuracy in recorder curve measurement over the particular angle being scanned.

1950 Raman Spectra of Germanium Tetrachloride and Lead Tetrachloride, by John T. Neu and William D. Gwinn. Journal of the American Chemical Society 70, p. 3463-3465, October 1948.

With a Steinheil type GH spectrograph, the Raman spectrum of germanium tetrachloride was taken. The frequencies ν_1, ν_2, and ν_4 agreed with those of other investigators. The correct value of ν_3 is 452 cm^{-1}, which differs from the value predicted by plotting the metal-halide distance against Raman shift. This difference may be explained by the germanium atom mass.

1951 Spectrochemical Determination of Beryllium. Increased Sensitivity of Detection in the Cathode Layer, by Jacob Cholak and Donald M. Hubbard. Analytical Chemistry 20, p. 970-972, October 1948.

A spectrochemical method for the determination of beryllium in biological material (Analytical Chemistry 20, p. 73, 1948) has been revised to take advantage of the increased sensitivity of detection made possible by volatilization from the cathode of the direct current arc. In quantitative procedures the method is sensitive to 0.001 microgram of beryllium in the arc, while as little as 0.00025 microgram can be detected in unweakened spectra. The most useful analytical range, employing the beryllium line at 2348.6 A, extends from 0.005 to 0.30 microgram per ml of prepared solution. The method described earlier is used to supplement the present method within the range of 0.2 to 2 micrograms beryllium per ml, and a separate working graph for the line pair beryllium 2650.8 A, thallium 2580.2 A is used for the range 2.0 to 30 micrograms of beryllium per ml of solution.

1952 Spectrographic Determination of Boron in Plant Tissue, by F. M. Smith, W. G. Schrenk, and H. H. King. Analytical Chemistry 20, p. 941-943, October 1948.

A spectrographic procedure of good precision for the determination of boron in plant ash employs the direct current arc for excitation. Tin is used as an internal standard and lithium chloride as a buffer. The plant material is ashed at 600°C. A weighed portion of ash is traced with hydrochloric acid, evaporated to dryness, and taken up in a solution of internal standard and buffer. A 0.1-ml aliquot is evaporated to dryness on the electrode. The sample is burned in a direct current arc with a blunt-nosed cathode. Line densities are determined with a densitometer and compared with those produced by standards of known concentration. Blunt-nosed cathodes are preferred for increased precision. A probable error of 1.43% was obtained with alfalfa samples containing 36.6 ppm of boron. With pointed electrodes a probable error of 2.70% was obtained with samples containing 28.4 ppm. The procedure agrees well with data obtained by the use of quinalizarin as a color-producing reagent. In nine alfalfa samples of varying boron content, spectrographic analyses averaged 6.3% lower than the colorimetric procedure. The method has also been successfully used on wheat grain. The simultaneous estimation of phosphorus, manganese, and magnesium by this procedure is possible.

SPECTROSCOPY (continued)

1953 Stark Effect in the Spectrum of Neutral Fluorine, F_I, by Kurt Lidén. Arkiv för Matematik, Astronomi och Fysik 35A, No. 23, 1948. 20 p.

The Stark effect in the F I spectrum was studied in the range of 35-180 kv/cm, with a glass-prism spectrograph. Shifts were measured for 44 lines belonging to the transitions $(^3P)3p - 4d$, $(^3P)3p - 5s$, and $(^1D)3s - 3p$. No observable effect was noted for the lines $(^3P)3s - 3p$. A discussion, based on the quantum mechanical perturbation theory, of the initial levels $(^3P)4d$, 5s, and $(^1D)3p$ is presented.

1954 Wave-length Measurements and New Energy Levels in the Arc Spectrum of Fluorine, F_I, by Kurt Liden. Arkiv för Matematik, Astronomi och Fysik 35A, No. 24, 1948. 13 p.

Using hollow cathode discharge tubes containing a mixture of He and SF_6 (10:1), the author studied the F I spectrum. A table is presented of wave-lengths, intensities, and term combinations for 60 new F I lines (5538.53A to 7109.63A). The lines are explained as electron transitions 3p - 5s and 3p - 4d. All theoretically possible $(^3P)5s$ and $(^3P)4d$ energy levels were determined.

1955 X-Ray Fluorescence Analysis, by J. L. Abbott. Iron Age 162, No. 18, p. 58-62, October 28; No. 19, p. 121-124, November 4, 1948.

X-ray fluorescence analysis provides a means of rapid, quantitative analysis. Approximately 3 to 5 min per element will be required after the sample is prepared. The analysis consists of inserting the sample, setting angles to detect the proper K (or L) radiation from the element desired, measuring the intensity of the radiation with the Geiger counter for the required time, and comparing the number of counts with that of a standard sample of somewhat similar composition. The accuracy to be expected varies somewhat with the nature of the sample, but optimum accuracy, in the order of one part in 10,000 of the element present, may be obtained under favorable circumstances. The analysis is independent (except for absorption effects) of the state of the element in the sample, whether it be free, combined, or alloyed. It is expected that the new method will soon be utilized along with the conventional chemical and spectrographic methods for routine quantitative analysis.

TRACER APPLICATIONS

1956 Isotopic Oxygen Consumption at Low Oxygen Tensions, by John E. Pickering, John M. Talbot, and Herman I. Chinn. Project No. 21-02-102, U. S. Air Force School of Aviation Medicine Quarterly Research Report, p. 17, July 1 to September 30, 1948.

Because of a great deal of controversy on this subject, it is proposed to determine the actual depth of penetration of oxygen in tissue slices in the Warburg Respirometer under varying oxygen tensions. Different thicknesses of tissue will be exposed to an atmosphere of isotopic oxygen. Serial sections of these exposed tissues will be rapidly prepared and the amounts of tracer oxygen present determined, giving a measure of the depth of oxygen penetration in the original tissue slices.

TRACER APPLICATIONS, RADIOACTIVE

1957 Radioactive Iodine: Its Use as a Tool in Studying Thyroid Physiology, by Rulon W. Rawson and Bengt N. Skanse. Radiology 51, p. 525-531, October 1948.

Studies in which radioactive iodine has been used in evaluating some of the physiologic reactions of the thyroid are reviewed. It has been found that thyrotropic hormone causes hypertrophy of the thyroid, loss of thyroid iodine, and increased avidity for administered iodine. Orally administered radioactive iodine is absorbed rapidly in the gastrointestinal tract and is found in the thyroid 20 minutes after ingestion. Urinary excretion of the radioactive iodine varies in different thyroid states, as in untreated Graves' disease, where it is so typical that its use is justified as evidence in diagnosing

TRACER APPLICATIONS, RADIOACTIVE (continued)

the disease where it is suspected. Benign tumors, in general, have less than the normal thyroid tissue ability to concentrate radioactive iodine and in a series of thyroid cancers concentration was exceedingly low. Present evidence that so-called tracer doses alter the normal physiologic pattern of the thyroid points out the necessity of determining the minimal dose and perfecting newer and more sensitive measuring instruments for carrying on this work. 16 references.and 2 tables.

1958 Studies of the Molybdenum Nutrition of Plants with Radioactive Molybdenum, by P. R. Stout and W. R. Meagher. Science 108, p. 471-473, October 29, 1948.

Young tomato plants grown in complete culture solutions were used in these short-time absorption experiments. By use of Mo^{93} (half-life, 6.7 hrs) or Mo^{99} (half-life, 67 hrs) a complete accounting of the absorption and subsequent distribution of a single microgram per growing plant was obtained. The roots accumulate molybdenum rapidly, but translocation to upper parts of the plant is strongly influenced by the phosphate ion concentration in the culture solution. The characteristic patterns of accumulation are distinctly different from those of other mineral nutrients such as potassium, phosphorus, manganese and zinc. Accumulation of molybdenum is around the points of greatest water loss in the leaves. It appears to be involved in the reduction of nitrates in the metabolic cycle. 11 references; 2 tables.

TRANSURANIC ELEMENTS

1959 Chapter I, Introduction [Chemistry and Metallurgy of the Transuranic Elements, NNES Volume, 14A], by G. T. Seaborg. AECD-2375 (ANL-JJK-14A-160), December 1947, decl. November 5, 1948. 10 p. For publication in NNES.

This volume will constitute a survey of present knowledge concerning the chemical and physical properties of elements of atomic number greater than uranium. The larger portion of the volume will be devoted to elements 94 (plutonium) and 93 (neptunium). In this introductory chapter, brief histories are given of elements 93, 94, 95 and 96 and their isotopes. 20 references.

1960 Nuclear Properties of Transplutonium Isotopes, by G. T. Seaborg. AECD-2376 (ANL-JJK-14A-161), December 1947, decl. November 8, 1948. 12 p. For inclusion in NNES.

This paper will serve as a section of "Chemistry and Metallurgy of the Transuranic Elements, NNES Volume 14A". The radioactive properties of the transplutonium isotopes are discussed and the ways in which they are produced are present. At present there are two transplutonium elements known, americium with atomic number 95 and curium with atomic number 96. The americium isotopes considered include Am^{238}, Am^{239}, Am^{240}, Am^{241}, 16-hour Am^{242}, long-lived Am^{242}, and Am^{243}. The curium isotopes considered include Cm^{238}, Cm^{239}, Cm^{240}, Cm^{241}, Cm^{242}, Cm^{243}, Cm^{244}, Cm^{245}, Cm^{246}, Cm^{247}. 9 references.

1961 Absorption Spectrum of Hexavalent Plutonium, by R. H. Betts and B. G. Harvey. Journal of Chemical Physics 16, p. 1089-1090, November 1948. (Letter to the editor)

The absorption spectrum of PuO_2^{++} was measured in 0.9 N nitric acid solution, using a Beckman quartz spectrophotometer. The spectrum between 3600 and 10,000 A is given and is seen to be similar to the spectrum of PuO_2^{++} in 0.1 N perchloric acid (Kasha, MDDC-591, U. S. Atomic Energy Commission, Oak Ridge, Tennessee). An enlarged reproduction is also given of the portion of the spectrum ascribed by Kasha to vibration. The absorption spectrum of Pu(VI) in dilute ammonium hydroxide solution was measured and is reproduced. The peak is shifted to longer wave-lengths, without a marked change in the extinction coefficient.

TRANSURANIC ELEMENTS (continued)

1962 Search for Elements 94 and 93 in Nature. Presence of 94^{239} in Carnotite, by C. S. Garner, N. A. Bonner, and G. T. Seaborg. Journal of the American Chemical Society 70, p. 3453-3454, October 1948.

This article is based on MDDC-1660. An abstract of this document has been listed in Abstracts of Declassified Documents II, p. 102, February 28, 1948.

URANIUM

1963 Diffusion Coefficients of Carrier-Free Fission Products in Uranyl Nitrate and Acid Solutions, by J. Schubert and E. C. Cohn. AECD-2377 (ANL-HDY-362), May, 1944, decl. November 8, 1948. 5 p. For publication in Journal of Chemical Physics. For sale by AEC.

In the experiments reported here, the diffusion coefficients of radiotracers from uranium fission were measured under conditions where the composition of the bulk electrolytes in both the upper and lower cells of McBain-Northrop sintered-glass diaphragm cells were identical except for the presence of about 10^{-14} M of radiotracer in the upper cell. The techniques, calculations and calibration procedures employed were essentially those described by McBain and Liu (Journal of the American Chemical Society 53, p. 59, 1931). A table is presented which gives the diffusion coefficients of carrier-free fission products (Ba^{140}, Sr^{89}, La^{140}, Zr^{95}, Cb^{95}, Ru^{103}, Te^{132}) in uranyl nitrate, in nitric acid and sulfuric acid solutions at 25°C. 9 references.

1964 Polarographic Determination of Uranium in Dust Samples, by Stanton B. Smith. AECD-2381 (Chem S-336), August 30, 1943, decl. November 15, 1948. 17 p. Document for sale by AEC.

Samples of dust collected from the atmosphere with electrostatic precipitator were analyzed for uranium by means of a dropping mercury electrode apparatus. Two to three micrograms of uranium can be detected in a cell solution volume of 1 ml. Iron, nickel and chromium present in shop dusts did not interfere. Copper might interfere if present in excess but may be removed by a sulfide precipitation. Directions for preparation of cell solution and operation of the polarograph are given. The polarographic method described may be used for determination of uranium in samples other than atmospheric dusts.

1965 The Structures of Some Metal Compounds of Uranium, by R. E. Rundle and A. S. Wilson. AECD-2388, n.d., decl. November 10, 1948, 12 p. For publication in Acta Crystallographica.

The compounds UAl_2, UAl_3, UAl_5, UHg_2, UHg_3, UHg_4, and USn_3 were studied. These compounds all were found to have standard type structures, except UHg_4 and UAl_5 which are quite complex. UHg_4 appears to be a distoration of a body centered cubic arrangement. The structure of UAl_5 remains unknown. All results reported are from powder data made with samples sealed in thin-walled glass capillaries. Powder cameras of 5.73 cm radius were used. Radiation was CuK α, and the Siegbohn wavelength, λ = 1.539 kX was used in reporting lattice constants.

1966 Fluorescence Test for Uranium in Aqueous Solution, by C. W. Sill and H. E. Peterson. Analytical Chemistry 19, p. 646-651, 1947.

In sulphuric acid solution, uranyl ions fluoresce yellow-green, stannic ions pink, and ceric ions white, but stannyl ions must be avoided; only one or two rare earths fluoresce. Relatively large amounts of uranium are masked by small amounts of reduced tin or cerium, but interference is removed by oxidizing the tin, and by precipitating cerium by sodium carbonate. Pyro-, ortho-, and meta-phosphoric and hydrofluoric acids enhance the fluorescence about tenfold, but with decreasing effect. The sensitivity does not vary over a wide range of phosphoric acid concentration, but the optimum hydrofluoric acid concnetration is 0.5 to 1.0 ml of 48 per cent solution in 200 ml. The enhancing effect decreases at higher concentrations, and is finally reversed. In general, phosphoric

URANIUM (continued)

acid is to be preferred. The details of the procedure are given and modifications of the procedure in the presence of vanadium and in the presence of chromium are presented.

1967 High Energy Spallation and Fission Products of Uranium, by P. R. O'Connor and G. T. Seaborg. Physical Review 74, p. 1189-1190, November 1, 1948. (Letter to the editor)

The yield distribution of the radioactive products produced by bombarding natural uranium with 380-Mev helium ions has been studied. A plot of relative yield as a function of mass number of the radioactive products shows what appears to be a continuous yield of radioactive products for the entire range of elements from the uranium region to elements down in the vicinity of atomic number 25. This is a great mass number range than that obtained in uranium fission produced by lower energy particles. A number of α-emitting isotopes with a mass number of about 210 for which a large yield was observed, are not shown; they were believed to be products of α-emitting chains.

From an estimate of the area under the fission part of the curve, the total cross section for the fission reaction was determined as roughly 2×10^{-24} cm^2; since the intensity of the helium ion beam was unknown, this value is very approximate. The distribution curve is interpreted as the result of two types of reactions: (1) spallation reactions, which probably account for the products from the uranium region down to those of mass number 180-200, and (2) fission reactions, which account for the products of lower mass number. Only a single peak in the region of maximum yield is observed at mass number 115, indicating the possibility that the maximum occurs at a mass number less than half that of the original compound nucleus; this is interpreted as adding some uncertainty to the mechanism of fission proposed by Goeckermann and Perlman (Physical Review 73, p. 1127, 1948), in which the process is preceded by neutron emission. The possibility of several mechanisms is discussed with reference to the observed distribution.

1968 Isatin β-Oxime and Its Use in Analytical Chemistry (Determination of Uranium), by V. Hovorka, V. Sykora, and J. Vorisek. Chimie Analytique 29, p. 268-275, 1947.

Isatin β-oxime in either of its possible tautomeric forms provides the conditions necessary for the formation of cyclic complexes. A 1 per cent solution of the oxime in 50 per cent alcohol yields precipitates with a number of metals for solutions of their acetates, or from solutions buffered with sodium acetate, as follows: silver (orange-red precipitate), $mercury^{II}$ (orange-yellow), $mercury^{I}$ (orange-yellow), $copper^{II}$ (olive-green), $copper^{I}$ (orange-red), lead (yellow), $iron^{II}$ (dull green), uranyl (yellow). Nickel and cobalt precipitates formed in the cold are amorphous and voluminous and entrain the electrolytes and the precipitant, the latter separating in crystalline form later. From hot solutions crystalline precipitates are obtained, particularly with silver, $mercury^{II}$, and uranium. $Cerium^{IV}$, $cerium^{III}$, thorium, and zirconium are not precipitated from acid or from acetate buffered solutions, but ceric salts oxidize the oxime in acid solution to isatin. With an ammoniacal solution of the oxime the ceric salt is precipitated quantitatively as an amorphous, red-brown substance; the thorium precipitate is light yellow and dissolves on washing with water; the zirconium and cerous precipitates are mixtures of basic salts and hydroxides.

The mercuric salt has the composition $C_8H_4O_2N_2Hg$ and the oxime here behaves as a dibasic acid. The composition of the silver precipitate varies with the conditions of precipitation. The uranyl compound has the formula $UO_2(C_8H_5O_2N_2)_2$ and is a cyclic complex; it is liable to contain entrained precipitant, but may be employed in the quantitative separation and determination of uranium. Procedures are given for the preparation of the reagent and for the gravimetric determination of uranium.

1969 A Modified Method in the Analysis of Uranium Ore with High Content of Columbium and Tantalum, by Pe-Nien Yu. Journal of the Chinese Chemical Society 15 p. 170-178, 1948.

Scott's method was modified by fusing the ore with $K_2S_2O_7$ and extracting with hot water. The uranium is precipitated by ammonia and weighed as U_3O_8.

URANIUM (continued)

1970 The System Uranyl Sulfate-Water. I. Temperature-Concentration Relationships below 300°, by C. H. Secoy. Journal of the American Chemical Society 70, p. 3450-3452, October 1948.

This article is based on MDDC-1767. An abstract of the document has been listed in Abstracts of Declassified Documents II, p. 194, March 31, 1948.

VACUUM SYSTEMS AND PUMPS

1971 A Comparison of Mercury Diffusion Pumping Speeds for Five Gases, by Donald Fluke. Review Of Scientific Instruments 19, p. 665-666, October 1948.

Mercury diffusion pumping speeds for hydrogen, helium, air, argon, and Freon have been measured for a pump of small aperture and found to vary inversely as the square root of the molecular weight. Curves of the pumping speed as a function of molecular weight and of pressure are shown.

1972 Diffusion Pump Pressure Gauge, by J. A. V. Fairbrother. Journal of Scientific Instruments and of Physics in Industry 25, p. 347-348, October 1948.

A pressure gauge suitable for giving a continuous record of residual pressure in an exhausted vessel such as a cyclotron or mercury-arc rectifier is described. It consists of a diffusion pump discharging back to the fine-pressure side through a throttle, the amplified fine-side pressure being read off on an oil- or bellows-type manometer connected across the throttle. The sensitivity of the gauge compares favorably with that of the McLeod gauge. Diagrams and the calibration curve are shown.

1973 A New Pump, by Louis W. Lewis. Review of Scientific Instruments 19, p. 698-700, October 1948.

A new type of pump is described which has the unique property of being able to move a fluid without change in pressure, volume, or temperature. Against a small external resistance, it can be used for pressure, vacuum, or circulation of a gas, and with a simple attachment, liquids may be pumped. A photograph of the pump is included.